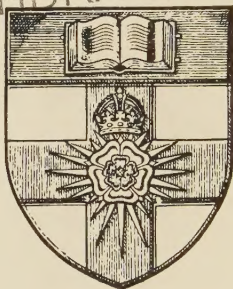
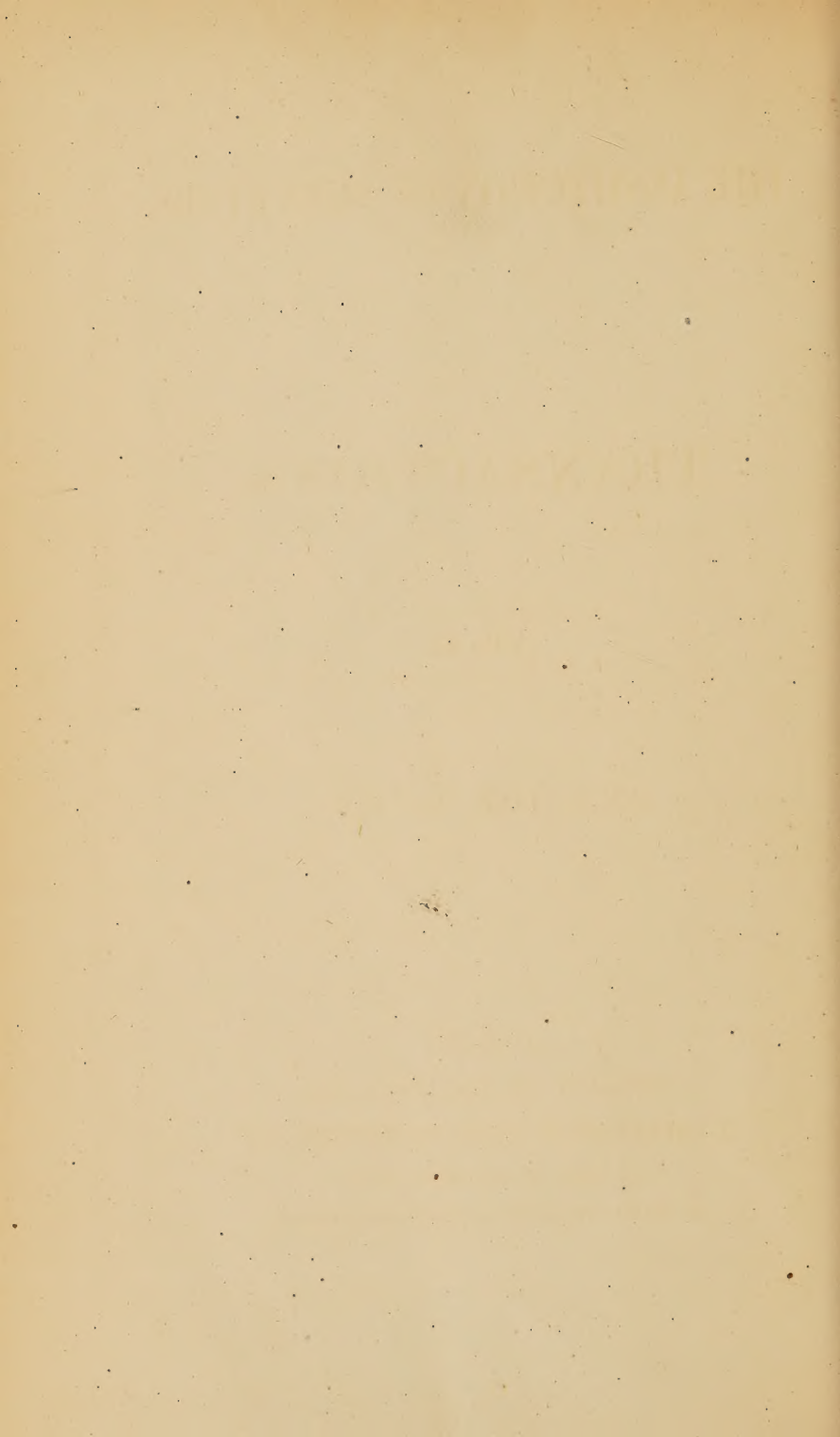


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THE INSTITUTION OF SURVEYORS.

TRANSACTIONS.

VOL. IX.

SESSION 1876-77.

LONDON:

PUBLISHED AT THE INSTITUTION,
12, GREAT GEORGE STREET, WESTMINSTER, S.W

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NOTE.

—♦—
This Institution does not, as a body, hold itself responsible for statements made or opinions expressed, either in the Papers read or in the discussions which have occurred, at the Meetings.

The Institution of Surveyors,

12, GREAT GEORGE STREET, WESTMINSTER, S.W.

OFFICERS, 1876-77.

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THIS COUNCIL WILL CONTINUE UNTIL MAY 1877.

The Institution of Surveyors

Is established—

1. To secure the advancement and facilitate the acquisition of that knowledge which constitutes the profession of a Surveyor, viz.—the art of determining the value of all descriptions of landed and house property, and of the various interests therein; the practice of managing and developing estates; and the science of ad-measuring and delineating the physical features of the earth.
2. To promote the general interests of the profession, and to maintain and extend its usefulness for the public advantage.

THE INSTITUTION consists of three classes, viz.—MEMBERS, ASSOCIATES, and HONORARY MEMBERS, with a class of STUDENTS attached.

A MEMBER must be more than twenty-five years of age, and have acquired a practical knowledge of surveying in one or other of its branches as above defined, and so practised on his own account for more than five years; or be a member of a firm of surveyors established upwards of ten years; or in partnership with a surveyor of ten years' standing. Every Member is eligible for election on the Council, for election or appointment to all offices of the Institution, and entitled to all its rights and privileges.

AN ASSOCIATE must be more than twenty-one years of age, not necessarily a surveyor by profession, but his pursuits must be such as to qualify him to concur with surveyors in the advancement of professional knowledge. Associates are not eligible for the offices of President or Vice-President, but are eligible for election on the Council or for election or appointment to other offices of the Institution; they have

access to the Library, subject to the regulations of the Council, and are entitled to vote and take part in the affairs of the Institution at all Annual, Ordinary, and Special General Meetings of Members and Associates.

AN HONORARY MEMBER must be a person who, either by reason of his position or his eminence in science and experience, may be enabled to render assistance in promoting the objects of the Institution, but who is not engaged in practice as a surveyor in Great Britain or Ireland. He has the privilege of being present and taking part at all Ordinary General Meetings, and of access to the Library, but no right of voting, discussing, or otherwise interfering in the affairs of the Institution; nor is he called on to contribute to its funds.

STUDENTS, not under eighteen years of age, may be admitted by the Council on the recommendation (according to a form) of four Members and two Associates, or of the Member or Associate to whom they are or have been articulated, and they may remain Students of the Institution at and during the pleasure of the Council, until they attain the age of twenty-one years, when they shall cease to be Students.

The Council may accord to Students such privileges, subject to such terms, regulations, and restrictions, as they shall from time to time prescribe.

Any person desirous of being admitted into the Institution (excepting to the class of Students) must be proposed and recommended according to a form, in which the full name, place of business (if any), usual residence, and qualifications of the candidate must be distinctly specified. This form must be subscribed by him, and signed by at least six Members or four Members and two Associates, certifying a personal knowledge of the candidate.

The proposal so made, being delivered to the Secretary, will be submitted to the Council, who, on approving the qualifications, will determine the class for which the candidate is to be presented for ballot at an Ordinary General Meeting of Members and Associates.

The following are the rates of contribution to the funds :—

	Annual Subscription.				Admission Fee.		
	£	s.	d.		£	s.	d.
<i>Student</i>	1	1	0	.	—		
<i>Associate</i>	2	2	0	.	3	3	0
<i>Member</i>	3	3	0	.	5	5	0

An Associate may compound for his annual subscription for twenty guineas, and a Member for thirty guineas.

With the view of forming a Library and Collection, all Members and Associates are expected, within twelve months after their election, to deliver to the Council an original Paper on some subject connected with the profession, or to make a donation to the Library or Collection.

The affairs of the Institution are under the management of a Council which is elected annually, consisting of a President, four Vice-Presidents, twelve Members, and two Associates. Besides the above, the Past Presidents, and the President or Chairman of any local Association in alliance with this Institution, are Members of the Council *ex-officio*.

The Session of the Institution commences annually on the second Monday in November, and continues to the end of May. The Ordinary General Meetings are held on every alternate Monday during the Session. At these Meetings original communications are read on some professional subject, and their merits fully and freely discussed. Every Member and Associate has the privilege of introducing one visitor to these Meetings. Members and Associates are entitled to a copy of any printed publication issued by the Institution after their admission.

THE OPENING ADDRESS

BY

EDMUND JAMES SMITH, PRESIDENT,

AT THE ORDINARY GENERAL MEETING OF

THE INSTITUTION OF SURVEYORS,

NOVEMBER 13TH, 1876.

GENTLEMEN,

My first duty in this Chair is to express my sense of the honour you have done me in desiring me to discharge the duties of your President for the current year. I feel deeply the responsibility which you have laid upon me, and the difficulty of maintaining the reputation established by my eminent predecessors; but I have confidence that you will extend to me such a measure of support as will enable me to meet any difficulties, and that you will recognise my anxious desire to maintain the character of this Chair, and the welfare of this Institution.

It has been said that there was little temptation to the older members of the profession to undertake the labour of assisting in its establishment. The Founder and the Members of the first Council were all men busily engaged; but they felt how much the discharge of their duties would have been facilitated if such an Institution had been in existence in their younger days, and if they had been able to supply any temporary deficiency of information by reference either to their older brethren or to a professional library. We did the best we could with our limited opportunities; but we do desire to impress upon the younger Members

that we confidently rely upon them also, in their time, to employ their advantages, not only for their own, but for the common good. We trust that this Institution, yet in its infancy, will soon contain within itself all the members of the profession, each desiring to maintain and to increase its credit and its reputation. In a financial point of view success has never been doubtful. It soon became necessary to enlarge our building, and with 214 Members at the close of its first year, it now contains 437 members. The temporary debt of £2,900, occasioned mainly by the provision of this admirable Hall, is in course of rapid extinction ; and the Library constantly increases, and, thanks partly to the liberality of the Duke of Bedford, partly to donations from other friends, we have already a Library of Reference which contains the best information on most subjects cognate to our occupation.

But your volumes of *Transactions* are the chief tests of your usefulness, and, as years pass on, they attract to themselves more and more an external influence. In the last Session the discussion of the Agricultural Holdings Act brought to this Hall more crowded audiences and more distinguished visitors than any previous discussion. The Institution, as such, holds no views, asserts no opinions ; but it affords an arena where all questions in which our varied interests are concerned may be fully discussed by individual members. When many minds present successively their views, the conclusions which had appeared to be incontrovertible when examined from only one point of view, are not infrequently perceived to have been founded on a limited basis, and to require modification. In no case should the responsibility of the adoption of any particular decision be imposed upon the members in the name of the Institution ; nor is there any such power in our bye-laws.

I have mentioned the Agricultural Holdings Act as the most prominent of our discussions during the last Session, but those upon the Valuation Bill were scarcely less important. That Bill was withdrawn, owing to the pressure of Parliamentary business, in order to be renewed in the coming Session, and that discussion was understood to have attracted the attention of some at least of those who are responsible for legislation. Whatever its provisions may be, the new Bill relates to a question of so much importance that it can hardly fail to be one of the subjects to occupy your attention in the coming Session; I trust that County Boards may be adopted.

The working of the Sanitary Acts, and the disposition of sewage, is another matter which requires much consideration. The protection of the domestic life and health of the people has been recognised only recently as a fit matter for legislation, notwithstanding that few subjects can compare with it in importance. It ramifies in so many directions—the pollution of rivers, and consequent defilement of the waters of the towns; the utilization of town sewage; the frequent contamination of wells by the proximity of cesspools and house drains—that the provisions of these Acts are constantly recurring in practice.

The Commons Inclosure Act of last Session was probably the best that could be passed; certainly was better than none at all. Public opinion, which thirty years ago applauded the man who made two blades of grass to grow where one grew before, is now exercised in keeping common lands unimproved. Except in the neighbourhood of towns, I know few commons which are not nuisances to the vicinity. They are the abode of a vagrant, lawless population; whose miserable hovels are the disgrace of the neighbourhood, and whose presence is its terror. The suburban common and

village green undoubtedly require to be preserved for the sake of recreation and enjoyment, the proprietors being properly compensated for their rights; but the commons which lie at the backs of cultivated parishes, far away from the villages and frequently at considerable elevations, require no protection. A few miserable sheep maintain an unhealthy existence upon the poor and starved herbage, while the well grown sheep of the adjacent cultivated farms are jealously kept away for fear of infections. The whole productive power of the land is probably less than one-fourth of its power if in severalty. Such a common has been supposed to belong to the lord of the manor and the commoners, and to be as much private property as an enclosed field, subject, like the field, to roads and pathways for the public. The recent Act contains a section enabling other persons, besides the lord and the commoners, to take steps to prevent any inclosure of portions of the common, by action in the County Court subject to an appeal to the Courts above, and this provision introduces an entirely new element in the inclosure of commons.

The Artizans' Dwellings Act was fully discussed in this room. Parliament wisely left the initiative to the persons locally interested, but in its desire to provide a prompt remedy for neglect, it has given its sanction to somewhat summary processes for the purchase of property. There may be reason in withholding the usual allowance for compulsion where property has been suffered to become a public nuisance, but it is not so easy to see why an owner of adjacent good and habitable houses, required for the full development of the improvement scheme, should be subjected to the same provision. If the words "within such area" in the 3rd clause of the Act mean only the area covered by unhealthy houses, the provision may be reasonable; but if

they mean the whole block, including neighbouring properties not condemned as unsanitary but needed to be taken to give completeness to the scheme of improvement, then the owners of good houses are punished for their proximity to bad ones. It is stated that a case involving the question of giving the allowance for compulsion upon healthy houses of large value has actually arisen, and the owner of this valuable adjacent property is waiting for the decision. The right of petitioning Parliament against any scheme is reserved, but subject to the liability, on the part of the appellant, of being saddled with the whole of the costs should a *majority* of the Committee present be of opinion that the petition is (not vexatious but) not justified by the circumstances. This is a risk which few petitioners would care to incur, and renders the right of petitioning of little value. This power of awarding costs was conferred on a Committee of Parliament, I believe, for the first time, in 1865, by the 28 Vict. cap. 27, and was "exercisable only where the Committee shall unanimously report that the promoters of a Bill have been *vexatiously* subjected to expenses." The difference between a majority of a Committee deciding that an opposition is not justified by the circumstances, and a Committee deciding unanimously that an opposition is vexatious, is very great.

One of the most remarkable events from our point of view that has occurred during the year has been the publication of what is known as the Domesday Book of 1873. Collated as it is, from written records in the care of the Assessors of Poores' Rates, it contains many inaccuracies, and many items such as gas works, railways, and iron works, which are misleading, culminating in the River Wear Commissioners possessing 3 acres of land and a rental of £20,609 per annum. Its appearance adds to our

admiration of the fulness and completeness of the Domesday Book of William the Conqueror. Eight hundred years have elapsed since the King's Scribes passed through the length and breadth of this same England (except the four northern counties), and recorded not only the proprietorship of the land, but, as was said at the time, every horse and pig that was maintained upon it.* No intermediate record exists relating to the whole country. As regards the properties of most of the Bishoprics and Chapters, a complete account was obtained about 1650, and the renewal of leases septennially for the succeeding two hundred years would afford much information as to the rise and fall of rents in that period. It is probable also that the Oxford and Cambridge Colleges would be able to supply the same information as regards their properties, and some principal landowners must have continuous rentals of their estates. In future no doubt this new record will be revised not less frequently than each quarter of a century.

The recorded owners in the original Domesday are stated as 54,000 out of a population probably of 3,000,000, and the new Domesday gives about 1,000,000 of owners, three-fourths of whom are the possessors of not more than an acre, leaving possessed of more than one acre about one quarter of a million out of a population of 20,000,000; of whom one-half inhabit towns and invest very little in land. In Northumberland the ownerships over an acre average 500 acres each; in Wilts they average 200 acres. In the rest of England they average from 100 to 150 acres. In the counties of

* Information of this latter nature is now given yearly in the Agricultural Returns, which afford such full and valuable details of the acreage under each kind of corn and green crops and of pasture land, and of every kind of stock which is maintained by our alternate system of husbandry.

Cambridge, Chester, Derby, Gloucester, Lancaster, Somerset, Stafford, Surrey, Worcester and West Riding of York, they average about 80 acres, and in Middlesex 50 acres. It is curious on reading over the names of the untitled nobility in the several counties of England, to note how many have occurred in the chronicles of Crecy, Poitiers, Agincourt, and the French and Scotch wars, and how many more distinguished themselves in the histories of the internal affairs of the country before the reign of George III. Some such as Musgrave of Edenhall and many more take us back to fairy lore and the unwritten traditions of a high antiquity. Some rest upon success in trade or professional distinction in law or in arms, some upon the distribution of property by the Tudor Sovereigns, and some upon the accidental possession of estates brought by the extension of our towns into fabulous value. Whether the law of entail which secures the estate for the most part against the extravagance and the folly of the direct heir by providing that it must pass in its integrity to the next descendant of the founder, is based upon a better principle than that which divides each estate amongst all the children of the founder, is a question which we need not stop to discuss, but it certainly has the effect of maintaining a long connection between the family and the tenantry, and secures the latter against the danger of the sale of the estate and its consequent transfer to strangers.

At the present time the state of agriculture requires special consideration, as there can be no doubt that the two last seasons have been wet and unpropitious, and the harvest, in many places, most unfavourable. But this is by no means the first time that we have experienced agricultural distress. The *Quarterly Review*, No. 57, registers great fluctuations from 1350 to 1820, and TOOKE

brings the account down to 1836, and distress has been occasioned, sometimes by the abundance of the harvest producing low prices, and sometimes by the deficiency of produce owing to the bad harvest. There is one statement which is always recurring in the old books, viz., that three successive bad harvests were never known to occur.

The loss by bad harvests meant much more under the older system of husbandry, when corn constituted nearly the whole agricultural returns, than under the alternate system in which corn and stock support each other. In the great agricultural panic of 1851, when the distressed state of agriculture throughout England was so admirably depicted in the columns of *The Times* by *The Times* Commissioner, both corn and stock were ruinously low. It will repay any one acquainted with the various districts, and with the particular farms described in 1851 by Mr. CAIRD, to compare their condition at that time with their state under their present occupations. He will find a more spirited husbandry, effective drainage, better buildings, much better cottages, much better wages, and general improvement; but he will rarely find any material increase of rent, irrespective of interest on the cost of improvement. There will be a larger capital employed, and a much larger yearly produce, but the rent will generally have increased barely to the extent corresponding to the capital expended in improvement. The fee simple value will have materially increased, in consequence of the enormous accumulation of capital in the interval. I have known an ordinary farm, lying between two competing proprietors, sold at 54 years' purchase on the utmost rent obtainable.

Some portion of the value of the increased produce is appropriated to interest on capital expended in drainage, in cottages, or in buildings; some to interest on tenants'

increased capital ; more is absorbed by increased wages ; a portion pays the increased rates and taxes.

The better buildings speak for themselves to the eye, the thorough drainage will hardly be disputed, but a comparison can be made as regards wages more easily than with regard to any other portion of the increased expenditure as compared with 1851. According to a table in page 512 of Mr. CAIRD'S Book, the average wages in twelve northern counties in 1851 were 11s. 6*d.* a week, and in twenty southern counties were 8s. 5*d.* a week ; and it is added that in the preceding eighty years there had been no increase of wages in several southern counties, for instance, in Suffolk and Wilts ; and an increase of less than fourteen per cent. in the eighteen southern counties mentioned by ARTHUR YOUNG in 1770.

It was time that wages should increase : and their increase in the twenty-five years since 1851 cannot be taken to average less than fifty per cent. on the rates above-mentioned. In Durham and the manufacturing counties the increase is more than fifty per cent. The reaction which has recently set in will probably prevent the present rates from materially increasing for many years.

Nor does the increase of fifty per cent. in the rate of wages measure the improvement in the condition of the labourer. All those articles of consumption which may be called home comforts,—tea, sugar, tobacco, &c.,—are reduced in cost some forty per cent., while clothes and other necessities are both better and cheaper. The cottage is frequently a little more costly than in 1850, but more comfortable, and in a sanitary point of view generally unexceptionable. The maintenance of close parishes has been rendered useless by the extension of the area of rating, and in consequence the cottage is placed as near as may conveniently be to the

labourer's work, and the fatigue of the daily walk to and from his place of labour reduced to its minimum.

One cause of the disproportion, in 1850, between the wages of 11s. 6d. in the north, and 8s. 5d. in the south, was the manufacturing demand for labour in the north; but this was intensified by the operation of the law of settlement which chained the labourer to the parish where he was born. This law was practically abolished in 1865, and only from that date has the labourer been free to take his labour, the only commodity he has to sell, to any part of the kingdom. This freedom was largely exercised during the demand, in 1873, for more men in the coal and iron districts in the north, many hundreds leaving the eastern and south-eastern counties and obtaining in the north 21s. a week or more for their labour, instead of 11s. or 12s. in the south. But if the wages were higher the work was harder, and the habits of life quite different from those to which the strangers were accustomed.

A colliery life, even if the man be employed on the surface, is rather a town than a country life. The pit is sunk, and a pit village of, probably, 300 houses is built very near to the pit. The houses are arranged in streets, and, the population causing a demand for consumable articles, the corners of the streets and perhaps a row of houses in the main road are made into shops. Every man lives under the observation of his neighbours.

Until a few years since, the cost of building a collier's house was barely £50, and it was one story high; the least costly now involve an expenditure of £100, and many of £120, and none are less than two stories. The new collieries have for some time a large proportion of persons of roving and unsettled habits, the refuse of the older collieries and inexperienced strangers; but the colliers in the older collieries

are a remarkably orderly set of men; generally Dissenters, for until within a few years the Church of England did not provide any means of worship save at the Parochial Churches, and the Parochial Church was generally miles distant from the colliery. Now, Church and School are generally to be found at a new colliery, as well as dissenting places of worship.

The southern strangers rarely settled down in the new colliery villages, and very many returned to their counties to the lower agricultural wages rather than retain the higher rate with harder and unaccustomed work in what was to them almost a foreign country. At the iron furnaces the Welsh form a large proportion of the population.

In 1851 wheat was 40s. a quarter, beef $5\frac{1}{2}d.$ per lb., and mutton 5d. per lb. We may now take wheat at 47s. a quarter, beef at 10d. per lb., and mutton at 8d. per lb., and such of us as have lived through the panic of 1851, and still more through the distress of 1836, when the year's average price of wheat was 39s. a quarter, with barley under 30s., and oats 22s. a quarter, can but feel that this year's distress, though severe in many districts, does not present the same features or press upon the country to the same extent as in that period in 1851, which has been so faithfully and graphically described by Mr. CAIRD, in his "English Agriculture." In 1853, the best harvest occurred that has ever been known, and agricultural distress became a thing of the past.

One half of our population is at present fed with wheat imported from distant countries, and that half of our consumption is brought from the Western States of America, or other distant places, at such prices that the other half of our consumption cannot, it is said, be grown so as to be

remunerative to the English grower ; and suggestions are made for the adoption of a different system of cultivation.

There is a wide difference between panic fear and a grave consideration of existing facts, and the impossibility of growing wheat at a price of 47*s.* a quarter is not to be admitted without clear proof. In the last forty years wheat has ten times averaged less than 47*s.* a quarter for the year ; in 1835 it was 39*s.* as before mentioned ; in 1851 it was 39*s.* ; in 1864 it was 40*s.* ; and in 1870 it was 47*s.* ; and on each occasion it soon rose materially. Whatever the causes, the facts are certain, and it may fairly be inferred that what has so often happened is not unlikely to happen again ; although it may be difficult to predicate the precise form and the cause of the change. The reaction from the excited prices of almost all articles of commerce, but especially of iron and coal, in 1874, necessarily affects the price of all articles of consumption, and it is much more difficult to say why the loan of money should be cheap, than why wheat should be cheap.

How a good state of moral and intellectual character in the labourer, supported by a full rate of wages, is to be managed so as to enable this country to compete with the labour of other countries where the labourer is not cultivated to so high a standard, nor used to the same comforts, is one part of the present difficulty ; and this will be met, in a great degree, by the substitution of intelligent supervision of machinery for the exercise of manual labour wherever such substitution is possible.

In 1851 the threshing-machine had hardly established itself, the imperfect arrangements for ploughing by steam were just commencing, and after that came the reaping-machine,—all successively requiring more mind than mere manual operations. At the present time all these pervade

the land, and are gradually assisting to exercise the intelligence of the agricultural labourer, and when this higher standard of intelligence is attained generally, it may well be that the increase of wages will be greatly compensated by more intelligent work. One of the points to which we have not sufficiently attended is that the use of the implements necessary to enable us again to produce at such prices as to be able to meet foreign importation, have not been adopted more thoroughly.

As I have before pointed out in this Hall, the rent of the Whitfield Example Farm was 44 per cent. of the value of the gross produce before the outlay upon it in 1840, and was 20 per cent. of the value of the subsequent gross produce, and yet was £375 afterwards as against £200 previously; the value of the produce having been £1,912 in the latter period, and £463 in the former. The further increase of produce will afford room for the satisfaction of all the various claims upon it, and every mechanical and manual economy in cultivation will increase the margin required to recompense the tenant for the additional outlay.

And again, every quarter of wheat brought from foreign countries, as it increases the demand for labour at its place of produce, tends to raise the labourers' wages there, so that the foreign grower has to undergo difficulties similar to those borne by the English grower. When prices thus become unremunerative to the foreigner the reflux of labour materially affects the rate of wages in this country. It is stated that, in the last year, the immigration to England from America was only one-third less than the emigration from England to America.

The present depression may be expected to pass away as previous depressions have passed away; searching out, however, in its progress the estates which remain

unimproved, undrained, without good cottages, without efficient buildings, and without confidence of tenure. But the estates of this class will, in 1876, bear but a small proportion to their extent in 1851.

Before concluding, I would observe that, in addition to the farming reports in Mr. CAIRD'S *English Agriculture*, there are some notices interspersed which may conveniently be followed to the present time. 1st. The Agricultural College at Cirencester had then been established but recently. After an interval of a quarter of a century, we regard it as one of the most useful institutions in the country, educating, at a moderate cost, a large proportion of the land agents and scientific farmers of the future, and conducted in a manner which has earned the approval of the great body of agriculturists. 2nd. The systems of tenant-right in Surrey, Sussex, and the West Riding are denounced as the subjects of deserved reprobation, as unjust to incoming tenants, and injurious to the landlord, as producing a system of fraud and chicanery which all intelligent farmers were desirous of seeing terminated: while, in Lincoln and Nottingham, the system of husbandry, with compensation to out-going tenants, is described as no whit superior to that of West Norfolk, where capital was not protected by any system of tenant-right. 3rd. The land round Stamford, lamented over by ARTHUR YOUNG in 1770 as uninclosed, with the words, "It is melancholy to think that, in an age wherein the benefits of enclosing are so well understood, such tracts should remain in such a comparatively unprofitable state;" and which in 1851 remained as they were in 1770, have since that period been inclosed and are recovering from centuries of neglect. There are still, however, some common fields not far from Stamford which are in as discreditable a state as they were a hundred years ago.

4th. The extent of improveable land in Cannock Chase (some 14,000 acres), is remarked upon ; the whole lying uncultivated. But, since 1851, this barren land has been found to contain coal, and the heretofore worthless property has realized not unfrequently £700 an acre. Cottages, coal pits, railways, have been made upon it, and the greater part is covered with a busy, industrious population.

Future statisticians would possess an invaluable store-house of information of the progress made in the intervening quarter of a century, if another such investigation as that of Mr. CAIRD, in 1851, could again be made by the same or any other competent investigator.

Returning to the special duties of my position, I have to state that the following subjects have been suggested, and that papers will be read on some of them during this Session :—

The Rating Act, 1874,
 Riparian Rights,
 Streams and Water Mills,
 Rainfall,
 Warping and Reclamation of Waste Lands,
 Rural Water Supply,
 Well Sinking, and Water bearing Strata,
 Rent;

and I am sure, that the papers of this year will bear comparison with those of any previous volume. Nor is it likely that the Session will pass without some special subject requiring discussion.

Mr. T. HUSKINSON (Past President) said that he rose to discharge a most agreeable duty—that of proposing a vote of thanks to the President for the excellent address which he

had delivered, an acknowledgment which he was sure that all would feel was due to him for the care and thought which he had evidently bestowed upon its preparation.

It had been said by a great authority, with regard to books, that some might be tasted, some swallowed, and some few chewed and digested. Applying this description to opening speeches, he need hardly say in which category he would put the address just delivered. It contained much matter which they might digest, and usefully discuss in future meetings.

With the President's remarks as to the success which had attended the efforts of those who had made the welfare of the Institution their care, all would heartily agree and would share the satisfaction with which he had referred to the numerous topics which had been from time to time so fully and usefully discussed at the meetings. Among these topics was one which came especially home to the majority of members—he alluded to the present state of agriculture, and the difficulties under which the farmers of England were at this moment labouring. His business lay largely with farmers, and he wished that many of them whom he knew could hear the observations of the President, calculated as they were to give comfort to minds oppressed by a degree of apprehension amounting almost to panic. He certainly knew of no period during the last 40 years in which the agricultural mind had laboured under feelings of greater perplexity and apprehension than at the present moment. It was very difficult to see with any clearness the causes of this state of things. The labour question, no doubt, formed a considerable element in the existing difficulties, and there had probably been within the last 30 years an advance of 30 or 40 per cent. in its commercial price; but that did not represent the full extent of the increase to the farmer, for

he was sorry to say that concurrently with that increase there had been a very serious deterioration in its quality. He did not think that the agricultural labourer of to-day was to be compared with his fellow of 20 years ago, in respect either of the quantity of labour he would perform, or in the quality of that labour.

The pressure of rural and local taxation was another difficulty. Separately, the new taxes of recent years might appear to be small, but in the aggregate they represented a very appreciable burden—materially increased of late by the new sanitary requirements, and by increased cost of highways ; and as regarded the question of Education, there was no denying that the immediate results were justly considered by the farmer as adverse to his interests, for he was called upon to pay rates for building schools and school-houses, with the prospect before his eyes, that the moment the agricultural portion of the population was educated up to a certain point, they would cease to come to the assistance of the farmer, and take themselves off to what they believed to be more agreeable or profitable employment. He was not surprised that the farmer took a somewhat narrow and jealous view of his rights in this direction ; but he was surprised that the farmer did not see or fairly appreciate the fact that periods of depression like the present were not unknown or infrequent in the history of agriculture—that he did not take a broader view extending over an average of years, and not consider that the conditions of the present and past year will necessarily prevail in the future. The lesson to be drawn from the past is that those bad times will pass away as in former periods, and be succeeded by a state of things which will again enable him to reap a fair return for his capital and labour. He was sorry, however, to say that he did not find the farmer in

this philosophic frame of mind. He said, "I know that for the last four or five years I have laid out much money, and suffered great loss, and I don't think in the future I am going to be better off, and I must ask you to reduce my rent to compensate for the loss I have sustained, or at any rate to secure me against future loss."

It was in vain that he pointed out, as the President had said, that "these things have often happened before, and have passed away." A great writer had said that "whoever allowed the past and future to predominate over the present had advanced in the scale of thinking beings." The farmers thought the present only should dominate the future.

At the same time he must say that he had never known the condition of farming matters so unsatisfactory as during the last few years, mainly owing to a series of bad seasons. He believed that in the midland counties there was hardly half as much corn grown during the last four years as in the preceding four years, and this, he thought, would account for many of the difficulties with which the farmer was now contending. It was the want of drainage on the heavy, cold wet land, bad buildings, the ill-allotment of farms, and other economical disadvantages of that description which made it so difficult in many cases for owners to find tenants, but he had no doubt that the defects of this kind would shortly be forced upon the attention of owners and agents, and that, in a few years, advantage would result from present adversity.

The President had given a comprehensive view of the past, and ground of hope for the future; and his great experience gave him such a command of facts that his conclusions might be safely accepted as a sound basis for opinion, and a safe guide to practice.

Mr. E. P. SQUAREY (Member) had much pleasure in

seconding the vote of thanks, A faithful picture of agricultural life and conditions during the period from 1851 to the present time, had been drawn by the President, and he had deduced from that survey conclusions of a hopeful character—a character which he (Mr. SQUAREY) sincerely trusted might be realized; but there were certain considerations which appeared to him to affect some of those conclusions, especially with reference to the labour question.

In 1851, Mr. CAIRD recorded the fact that the Wiltshire labourer received, on the average, about 8s. 6d. a week. This statement was probably perfectly correct, as also the President's statement, that the average rate of wages in Wiltshire at the present time was 11s. to 12s. a week, but in contrasting these figures, certain modifying circumstances must be taken into consideration. He believed that all who were acquainted with Wiltshire would agree with him, that the number of men receiving 11s. now was considerably less than that receiving 8s. 6d. in 1851, and hence it was not a fair expression of the increase in the cost of agricultural labour to take these two rates of wages at their respective dates and multiply them by the same numeral. His experience (in cases where he had been able to examine the facts), with regard to the increase in the cost of labour, had been that, in the home and southern counties of England, it had not been such as to justify the complaints made by farmers, while the use of machinery had wonderfully reduced its cost.

The strictly commercial principle had been very properly applied by the farmer in saying to his labourer: "If you insist on having the full market value of your labour for the whole of the year, I must exercise the same principle, in my own behalf, by paying you the wages you are worth to me in harvest or haymaking time, and the minimum sum

you are worth in the winter." It would be found, he believed, that an investigation applied to, say, 25,000 acres of land in Wiltshire or Dorset, would demonstrate the fact that the increase in the cost of agricultural labour was not more than from 10 to 15 per cent. He quite concurred in the observation of Mr. HUSKINSON as to the deterioration in the quality of labour and the extent to which the fact told against the farmer at the present time. He believed that a well-placed man, farming 400 or 700 acres of land, would be quite content if he received (what he, Mr. SQUAREY, believed was a fair return on capital) $7\frac{1}{2}$ to 8 per cent. on an arable farm, with his horse and his sport found him. The constant liability to fresh demands on the part of the labourers so upset the farmers that many of them were disposed to retire from farming operations, and this had led to some difficulty in letting farms. This difficulty however would not, he believed, be of long continuance. Farms were already letting better than they did six or eight months ago, and there was a more hopeful appearance about the whole business.

The PRESIDENT, after acknowledging the vote of thanks, said he trusted that, on the termination of his period of office, the Members would be as kindly disposed towards him as they had shown themselves to be at its commencement.

The Meeting then adjourned.

THE RATING ACT, 1874.

BY W. STURGE (VICE-PRESIDENT).

*Read at the Ordinary General Meeting of the INSTITUTION OF SURVEYORS,
November 27th, 1876.*

THE PRESIDENT IN THE CHAIR.

ALTHOUGH this Act came into operation on the 6th of April, 1875, yet its provisions were not generally carried into effect at that date, and, in some instances, not before the earlier part of the present year. This delay probably arose from the difficulties experienced by the Overseers and Assessment Committees in applying the provisions of the Act to the several descriptions of property which have now for the first time become rateable. Even now the application of these provisions appears to be very imperfectly understood, not only by the Overseers and Assessment Committees, but also by some Surveyors who have not carefully studied the Act. I therefore think that advantage will be derived, both by Landowners and Surveyors, from a discussion of the Act by this Institution, consisting, as it does, of members from every part of England and Wales. With the object of commencing such a discussion, I propose in this Paper to express some thoughts which have occurred to me in the course of my own practice in carrying the provisions of the Act into effect.

The third section of the Act, after reciting the 43rd Elizabeth, cap. 2, intituled, "An Act for the Relief of the Poor," enacts that from and after the commencement of

this Act the Poor Rate Acts shall extend to the following hereditaments in like manner as if they were mentioned in the recited Act of the forty-third year of Queen Elizabeth, that is to say—

- (1) To land used for a plantation, or a wood, or for the growth of saleable underwood, and not subject to any right of common.
- (2) To rights of fowling, of shooting, of taking, or killing game or rabbits, and of fishing, when severed from the occupation of the land.
- (3) To mines of every kind not mentioned in the recited Act.

As to plantations and woods, the fourth section enacts as follows, viz. :

“The gross and rateable value of any land used for a plantation, or a wood, or for the growth of saleable underwood, shall be estimated as follows :

- “(A) If the land is used only for a plantation or a wood, the value shall be estimated as if the land, instead of being a plantation or a wood, were let and occupied in its natural and unimproved state.
- “(B) If the land is used for the growth of saleable underwood, the value shall be estimated as if the land were let for that purpose.
- “(C) If the land is used both for a plantation or a wood, and for the growth of saleable underwood, the value shall be estimated either as if the land were used only for a plantation or a wood, or as if the land were used only for the growth of the saleable underwood growing thereon, as the Assessment Committee may determine.”

The fourteenth section repeals as much of the Act of the 43rd of Queen Elizabeth as relates to the taxation of

an occupier of saleable underwoods from the date at which the provisions of the new Act come into operation.

I now proceed to state my views as to the rating of "land used only for a plantation or a wood," referred to in section 4, sub-section (A).

Much difference of opinion has arisen as to the meaning of this sub-section. In many instances Overseers and Assessment Committees (often composed of farmers interested in rating this description of land as high as possible) have interpreted the meaning to be that such land is to be rated at the same value as the adjoining agricultural land. This view is obviously fallacious, for the adjoining land is rated at its value to be let and occupied in its cultivated and improved state, whereas the words of the Act are that such land shall be rated "as if it were let and occupied in its natural and unimproved state." In a recent case, in which the writer appeared before an Assessment Committee to object to the rating of some very poor hill land used for timber woods, the Overseer stated in defence of the rate that he would take the land at a rent equal to the amount at which it was assessed, and when asked for what purpose, he replied, "To do what he liked with it"—in other words, to cut down and sell the timber, and then convert the land to any purpose he might think proper! Yet the Assessment Committee, with the principal tenant farmer in the parish in the Chair, considered this evidence conclusive, and dismissed the objection, leaving the Landowner to incur the expense of an appeal to Quarter Sessions, in order to obtain justice.

Another common view is that the land is to be assessed at its value to grub and cultivate. A large proportion of the woodland in this country would not pay to bring into cultivation; but even where it would pay, an assessment

based on this principle would not represent the value of the land "as if it were let *and occupied* in its natural and unimproved state." The words "and occupied" show that the meaning is that the lands are to be rated, not as if they were improved, but as if they continued to be occupied in their natural and unimproved state.

For the purpose of stating my own view of the true meaning of the sub-section, I cannot do better than, to quote the language of a report I recently made in reference to an Appeal to Sessions against the decision of an Assessment Committee, as follows, viz.: "For the purpose of estimating the value of the lands used as plantations or woods, I assume that the words "natural and unimproved state" mean lands of the same quality if they were unreclaimed waste, unfenced, and more or less overgrown with the natural products of land in this state, such as furze, fern, heath and brambles interspersed with patches of pasture." In other words, the land should, in my opinion, be valued as if it were uninclosed waste or common land. The value of such land for occupation in that state depends on the quality of the soil, the level, whether flat or steep, the altitude, and climate. In mountain districts the value may range from 1s. to 2s. 6d. per acre; in better localities from 5s. to 7s. 6d. and 10s. per acre; and in a few exceptional cases of alluvial or very rich soil, as high as 15s. to 20s. per acre, including the right of sporting.

I now come to the rating of "land used for the growth of saleable underwood," referred to in sub-section (B).

Under the provisions of the Act 43rd Elizabeth (now repealed so far as relates to the rating of saleable underwoods), the underwood itself, and not the land upon which it grows, formed the subject-matter of rating. The usual method of estimating the value was to divide the average

value of the produce of each fallage by the number of years growth, and to deduct from the result the annual expense of sale, fencing, protection and replanting, tithes and taxes. But under the provisions of the Act of 1874, the value of land used for the growth of saleable underwood shall be estimated as if the land were let for that purpose, and this alteration seems to me to have the effect of introducing a new element into the estimate of value, viz.: the interest on the capital which a tenant must, on entry, invest in the growing crop of wood. If a landlord were to let his woods to a tenant without payment for the growing crop, the rent would represent the value of the land plus that of the growing crop, which is not rateable. The rent of the land would be that which a tenant would give after providing, in addition to all expenses, for interest on his capital. If I am right in this view, the effect of the new Act is to reduce the rateable value of lands used for the growth of saleable underwoods. For example, under the Act of Elizabeth, the value of saleable underwood, producing £14 at intervals of fourteen years, would be estimated as follows, viz.:

	£	s.	d.
Gross average produce £14 ÷ 14 years .	1	0	0
Deduct:		s.	d.
Ditching, fencing, draining, say .	2	0	
Workman's wages, protecting, say	2	0	
Replanting or filling-up, say . .	1	6	
Tithes and taxes	3	0	
Sale expenses	1	6	
		0	10 0
Leaves rateable value		0	10 0

Assuming the wood to be in a regular course of cutting,

one-fourteenth part in each year, the growing crop would average seven years' growth, and would be worth half the gross value of the crop when arrived at maturity, or £7 per acre, the interest on which would be 7s. per acre, and this deducted from 10s. per acre, the value before arrived at, would leave 3s. per acre as the rateable value, exclusive of the right of sporting.

To this view of the case it may be objected that the crop of wood gives an additional value to the land in the same way that the fruit-trees planted in an orchard add to the value; and that, inasmuch as the rateable value of an orchard is that of the land plus that of the fruit-trees, so the value of a coppice-wood is that of the land plus that of the wood. It is true that the stools of the wood are analogous to the fruit-trees, both being permanent additions to the value of the land; but the crop of wood growing upon them is analogous to the fruit, and is the property of the tenant, who would pay for it on entry, and would be entitled to be paid for it on quitting, and who, having to invest his capital in it, would be entitled to interest thereon, which would be an element of deduction in estimating the letting value of the land.

As respects the lands referred to in sub-section (c), used both for a plantation or a wood, and for the growth of saleable underwood, the Assessment Committee may at their option rate them either as if the land were used only for a plantation or a wood, or as if it were used only for the growth of saleable underwood, but not for both purposes combined. In some cases the land would be worth more for one purpose than the other—depending upon the quality of the soil, and the quantity of timber interspersed with the underwood. We are all aware that where there is much timber there is but little underwood; in many cases

not enough to pay the expenses ; and, in these cases, the Assessment Committee would probably elect to rate the land at its value, to be let and occupied in its natural and unimproved state.

I now come to the rating of rights of sporting. When not severed from the occupation of the land, these rights formed an element in estimating the rateable value under the provisions of the Act of the 43rd Elizabeth, but not so when they are severed from the occupation. "The Rating Act, 1874," section 3, sub-section (2), extends the liability to rating to the latter case. Section 6, sub-section (1), enacts that "Where any right of fowling, or of shooting, or of taking or killing game or rabbits, or of fishing (hereinafter referred to as a right of sporting), is severed from the occupation of the land, and is not let, and the owner of such right receives rent for the land, the said right shall not be separately valued or rated, but the gross and rateable value of the land shall be estimated as if the said right were not severed ; and in such case, if the rateable value is increased by reason of its being so estimated, but not otherwise, the occupier of the land may (unless he has specifically contracted to pay such rate in the event of an increase) deduct from his rent such portion of any poor or other local rate as is paid by him in respect of such increase ; and every Assessment Committee, on the application of the occupier, shall certify in the valuation list or otherwise the fact and amount of such increase."

It is obvious that the mode of carrying this provision into effect is, firstly, to estimate the letting value of the holding, including the right of sporting ; secondly, to estimate the value, assuming the right to be reserved ; and then to deduct the one from the other, the difference being the value of the right of sporting. The question here arises,

What is the extent of the reservation in any particular case? Is it absolute? In other words, does it entitle the landlord to keep up an indefinite head of game and rabbits, without the payment of compensation to the tenant? Or is it limited by an agreement to pay compensation, if serious damage be done? It seems to me that, in apportioning the rateable value of the entire holding between the landlord and tenant, the Assessment Committee must take into account the terms of the letting. Practically, it would seem to come to this—what additional rent would a tenant give for his holding to include the right of sporting?—and this would be the measure of the landlord's share of the rates. As a general rule, game and rabbits are reserved in agreements for lettings, with no covenant to pay compensation for damage; but some landlords have the reputation of being much greater game and rabbit preservers than others; and it is obvious that for this reason a farm is worth less to rent under some landlords than under others, according to the extent of their game-preserving proclivities. It seems to me, therefore, that no general rule can be laid down for the apportionment of the assessment between landlord and tenant, but that each case should be determined upon its own state of facts.

The next question is, how to rate rights of sporting when severed from the occupation of the landlord and let to a separate tenant? In this case, the gross and rateable value must be estimated according to the ordinary rule of law, viz., on an estimate of the rent which the hereditament will command from year to year, deducting therefrom the expenses necessary to maintain such rent. In making this estimate, the actual rent paid by the tenant of the sporting right is not in all cases a criterion, as it depends upon the question, whether the landlord or the tenant pays the keepers' wages

and the expenses of breeding; and whether the right of sporting let be absolute or limited; subject to the payment of compensation to tenants or not. The true criterion of value would seem to be the rent which a tenant would give for the right of sporting, absolute or limited, as the case may be, taking upon himself all the expenses of preservation.

In practice, the Assessment Committees have adopted some scale of value supposed to be adapted to their special localities, varying from 1s. to 1s. 6d. and 2s. per acre for cover-shooting, and from 3d. to 6d. and 1s. per acre for field-shooting, according to the nature of the country, and the distance and means of access from the Metropolis and other large towns, making no distinction between the cases in which the sporting right is in the hands of the landlord or let. In some cases, in which the landlord keeps the right of sporting in his own hands, the overseers have rated him separately in respect of it, instead of including it in the rating of the holding, and then apportioning the amount between the landlord and tenant as provided in the Act, section 6, sub-section (1).

Section 6, sub-section (2) enacts that wherever any right of sporting severed from the occupation of the land is let, either the owner or the lessee thereof may be rated as the occupier at the option of the persons making the rate.

Sub-section (3) enacts that, subject to the foregoing provisions of section 6, the owner of any right of sporting, when severed from the occupation of the land, may be rated as the occupier thereof. Sub-section (4) defines who in certain specified cases shall be deemed to be the owner of the right.

I now come to the rating of mines, a subject which I approach with diffidence, as it is more within the province

of the mining than the land surveyor, and my practice has extended only to a few collieries in my own neighbourhood.

Coal-mines being the only mines mentioned in the Act of 43rd Elizabeth, it was held that all other mines were exempt from the payment of rates, except that the Courts have decided that, in the case of other mines, where the lords' dues are reserved in kind, the lord is rateable in respect of those dues. "The Rating Act, 1874," does not alter the law as respects mines previously rateable, but extends the liability to mines of every description.

The Act contains special provisions as respects the rating of tin, lead, and copper mines, as distinguished from other mines, for what reason I am not aware.

Section 7 enacts that "Where a tin, lead, or copper mine is occupied under a lease or leases granted without fine or reservation, wholly or partly, of dues or rent, the gross value of the mine shall be taken to be the annual amount of the whole of the dues payable in respect thereof during the year ending the thirty-first day of December preceding the date at which the valuation list is made, in addition to the annual amount of any fixed rent reserved for the same which may not be paid or satisfied by such dues.

The rateable annual value of such mine shall be the same as the gross value thereof, excepting that where the person receiving the dues or rent is liable to repairs, insurance, or other expenses necessary to maintain the mine in a state to command the annual amount of dues or rent, the average annual cost of repairs, insurance, or other expenses for which he is so liable shall be deducted from the gross value for the purpose of calculating the rateable value."

The section proceeds to explain the application of the foregoing principles to cases in which tin, lead, or copper

mines are occupied under leases granted wholly or partly on a fine, or occupied by the owner, or to which the foregoing provisions do not apply.

The section next proceeds to define the meanings of the terms "mine," "dues," "lease," and "fine." The term "mine" is defined as follows, viz. :—

The term "mine," when a mine is occupied under a lease, includes the underground workings, and the engines, machinery, workshops, tramways, and other plant, buildings not being dwelling-houses, and works and surface of land occupied in connection with, and for the purposes of the mine, and situate within the boundaries of the land comprised in the lease or leases under which the due or dues and rent are payable or reserved.

The term "dues" means dues, royalty, or toll, either in money, or partly in money and partly in kind; and the amount of dues which are reserved in kind means the value of such dues.

The term "lease" means lease or sett, or license to work, or agreement for a lease or sett, or license to work.

The term "fine" means fine, premium or foregift, or other payment or consideration in the nature thereof.

It will be seen that the term "mine" includes the engines, machinery, workshops, tramways, and other plant, buildings and works, and surface of land occupied in connection therewith in those cases only where a mine is occupied under a lease. It follows that in the case of a mine occupied by the owner these adjuncts are not included in the term.

The question here arises, whether, in the assessment of a mine occupied by the owner, according to the words of the Act, at "the annual amount of the dues, or dues and rent, at which the mine might be reasonably expected to let,

without fine, on a lease of the ordinary duration," such value should include the engines, machinery, workshops, tramways and other plant, buildings and works, and surface land? In letting the mine, the owner would require a fixed rent for all these adjuncts, in addition to the dues or royalty reserved in respect of the mineral, or he would require a larger scale of dues or royalty than he would require in the event of the lessee providing these requisites at his own expense. I conclude that this fixed rent, or increased dues or royalty, would be liable to be rated, inasmuch as property of the like description is rateable in the case of a mill or manufactory (the rating of the machinery not being carried further than the motive power).

The same principle would necessarily hold good in the case of a mine actually let by the owner, with a fixed rent reserved for the surface-land, buildings, and machinery, and dues or royalty for the mineral.

But the more common practice in letting mines is for the owner to let the minerals under a given area with sufficient surface for working the same, and for the lessee to sink the shaft, open the workings, and provide the buildings, engines, machinery, and plant. In this case, the owner would receive dues or royalty for the mineral, but there would be no rent in addition, except, perhaps, for the surface-land.

Now, inasmuch as the Act enacts that, in the case of a tin, lead, or copper mine occupied under a lease, the gross value shall be taken to be the annual amount of the dues in addition to any fixed rent, and a mine so occupied is defined to include engines, machinery, buildings, and plant, for which, in this case, no rent would be payable, because they would be the property of the tenant, it follows that these adjuncts would not be rateable, though they would be so in

the case of a mine occupied by the owner, and in the case of a mine let with a fixed rent payable in respect of them.

If I am right in my views as to the meaning of the Act, this is an anomaly in its provisions which requires explanation. Perhaps some member of the Institution, more versed than myself in the rating of mines, may be able to place the matter in a different light.

The Act contains no special provisions as to the rating of mines other than those of tin, lead, and copper; further than that, the Act of the 43rd Elizabeth, cap. 2, shall be extended to mines of every kind. All such mines have, therefore, become rateable on the same principle as a coal mine, viz.: "At the rent at which the same may be reasonably expected to let from year to year, free from tithe-rent-charge, and all usual tenants' rates and taxes, deducting therefrom the repairs, insurance, and other expenses necessary to maintain the premises in a state to command such rent." As the application of this principle of rating to coal mines is well understood, I need not dilate on its application to mines of other descriptions.

Section 8 enacts that, in the case of existing leases of mines exempt from the payment of any poor or other local rate, the lessee may (unless he has specifically contracted to pay such rate in the event of the abolition of said exemption) deduct from any rent, royalty, or dues payable by him, one-half of what such rate would amount to if calculated upon the amount of rent, royalty, or dues, &c., payable by him.

I have now gone through the main provisions of this Act of Parliament, the practical application of which appears to me to be by no means free from doubt and difficulty. I have endeavoured to analyze and explain their effect to the best of my ability, and if in any instance I am

wrong, I shall be happy to be corrected by any more experienced Member who may take part in the ensuing discussion.

Mr. E. RYDE (Vice-President) proposed a vote of thanks to Mr. STURGE for his Paper. He said that Mr. STURGE had complained that a long time had elapsed before the Act had been put into operation, and even now it was not generally carried into effect. But Mr. STURGE did not refer to the personal interest which Surveyors had in the working of the Act. The fact was that the rates and assessments arising under this Act were so large in amount, and the commission payable to Surveyors in respect of them so considerable, that Assessment Committees hesitated before they incurred the liability. Whether the members regarded him as speaking ironically or not, they might depend upon it that to some such question it was greatly due that this Act of Parliament was not more generally used. The working of this Act was just what he always expected it would be. He had said before, and would say now, that the Act of Elizabeth was a striking illustration of the wisdom of our ancestors. No other Act of Parliament had lasted so long and worked so well as that Act, and the reason why the present Act had not worked better than it had, was because it tampered with the good old Act of Elizabeth. It should always, he thought, be borne in mind, in discussing these subjects, that the rateable value of an hereditament was the rent that it might reasonably be expected to let at. The determination of that rent was a matter of judgment, and the moment one began to lay down hard and fast rules for determining the value of any particular kind of property, the difficulties described by Mr. STURGE began to present themselves. The Act

of Elizabeth probably intended that everything should be rated, but as the words "saleable underwood" were mentioned in it, it had been decided that all other woods were intended to be left out.

Then, as to shooting. Land was to be rated at what it might be expected to let at, with all its advantages and all its appurtenances, including the right of shooting. But the man who had the land without the right of shooting, objected to be rated as though he had that right, and therefore some provision had to be made, since somebody should be rated for the entire value.

Again, coal mines were mentioned in the Act of Elizabeth, and therefore it was assumed that all other mines were not intended to be rated. What was wanted was a short Act of Parliament, containing about two clauses,—the first enacting that, notwithstanding any words in the Act of Elizabeth, all property should be rateable, and the second that, inasmuch as the right of sporting was sometimes severed from the occupation of the land, the tenant of the land should be rated for its full value, but should be entitled to recover from the landlord or the occupier of the sporting rights, the fair proportion of the value of the whole. If some provision of that kind had been made, the legislation would have been, in his judgment, more perfect than it now was.

In his endeavour to discuss the subject, he would first of all call particular attention to the words, "natural and unimproved state," as applied to land used only as a plantation or wood. He supposed that whoever drew the Act of Parliament, must have regarded land as it was in the time of Noah, which was then in what might truly be called its "natural and unimproved state."

Attention had been called by Mr. STURGE to the fact that some people have interpreted the meaning of

these words to be, that such land should be rated at the same value as the adjoining agricultural land; but it often happened that land was planted with wood because it was an inferior piece of a field, or because it was something which would not pay for cultivation as arable land. To rate such land equal to the adjoining land would be contrary to common sense. But such land might be rated as "mere land," at less than the adjoining land, if it were left to some competent man to do it, unfettered by the directions of an Act of Parliament as to how he was to do it. Mr. STURGE had referred to the statement of an overseer that he would take the land involved in a certain inquiry at a rent equal to what it was assessed at, for the purpose of doing what he liked with it, and inferred from that that he was to be at the expense of cutting down the timber and grubbing the land. He (Mr. RYDE) thought it must be regarded as naked land, without the timber; and if the overseer meant that if he paid rent for it as naked land he would have a right to do as he liked with it, he was of opinion that he was not far wrong. He did not think it followed that the land need be unfenced: the fence of the surrounding land might be the fence of the woodland.

He would now pass on to the value of the saleable underwood; but taking a little exception to his friend (Mr. STURGE's) arithmetic. Assuming the underwood to be worth, as Mr. STURGE had, £14 at the end of fourteen years, or as they would say in Kent "£1 a shot"—that was £1 per annum—and assuming the expenses to be 10s. per annum, as Mr. STURGE had printed them in his Paper, it was erroneous to assume that there remained a rateable value or rent of 10s. per annum. If a man had to pay 10s. expenses for ditching, fencing, drainage, workmen's wages, protecting the wood, replanting, filling

up, tithes, and taxes, and sale expenses, and a rent of 10s. (he would have to pay his rent annually), it amounted to £1 a year; so that, at the end of fourteen years, he would only get back the money he had paid, without interest or remuneration of any kind. If one had to pay £1 a year for fourteen years before getting a return, £19 12s. would be required to recoup the outlay—that being the amount of £1 a year at 5 per cent. compound interest, with no remuneration for all the trouble and labour in looking after the thing. The following estimate represented what he thought was sound. A crop of the value of £14, at fourteen years' growth, would only recoup an outlay of 14s. 3d. per annum, at compound interest, at 5 per cent. If 10s. of this be taken to be expenses, there remained only 4s. 3d. for landlord's rent and tenant's profit. This should, probably, be divided equally, but as Mr. STURGE might have charged in the 10s. too much for rates, say 1s. 9d. to the tenant and 2s. 6d. to the landlord. This 2s. 6d. was the rateable value. If, however, the period within which the crop can be cut be diminished—that was to say, if the fourteen years could be reduced to twelve years—the 2s. 6d. became 4s., and if it be reduced to ten years the rental value became 6s. 2d.

	14 years.	12 years.	10 years.
	£ s. d.	£ s. d.	£ s. d.
Amount per annum which, at 5 per cent. compound interest, will amount to £14, the value of the crop at end of	0 14 3	0 17 7	1 2 3
Deduct Expenses, as per Mr. STURGE	0 10 0	0 10 0	0 10 0
Remains for Tenant's profit and Landlord's rent... ..	0 4 3	0 7 7	0 12 3
Deduct Tenant's profit... ..	0 1 9	0 3 7	0 6 1
Leaves Landlord's rent	0 2 6	0 4 0	0 6 2

A very common error prevailed in many quarters that sporting rights not severed from the occupation of the land were still not rateable. That was not so—they were rateable under the old Act. In the case of sporting rights, the occupier of the land should in any case have been rated, and should have had the power to recover the amount paid in respect of the sporting rights. Land with its agricultural value and the rights of sporting was worth a certain rent. Land without the right of sporting, (*i.e.*, those rights reserved for somebody else,) was worth another rent. Sporting without any interest in the land was worth another rent. But it did not at all follow that the value of the two things when severed, was equal to the value of the whole. There was a very great difference between having a thing in its entirety and being able to do what one liked with it, and having a part only in common with some one else, each being able to worry the other.

The tinkering or tampering with the Act of Parliament, to which he had before referred, had been carried to a greater extent in the case of mines than in anything else. But he thought it was never intended that the construction should be put on it that Mr. STURGE had put on it. He thought that, in valuing a mine, it was intended that the mine should be taken (including the workings below, and all the hereditaments above ground) at what it was worth in its entirety; and if, in the case of a mine in the occupation of the owner, the land which lay on the surface was not mentioned, it was because under the old Acts such land was rateable before.

In the case of mines not rateable, at the time when an existing lease was granted, but now rateable, provision was made in the Act that the landlord should bear half the loss, and the tenant half. He would have thought they would

have borne the increased burden in proportion to the value they each had in the mine. If it were let at a low rent, the lessee would have a larger interest, and should bear a larger proportion than the landlord. That was one part of the Act which will soon wear itself out. Leases would soon expire, and, if there were injustice in it, it was limited to the present leases, and would die out with those leases.

Mr. R. C. DRIVER (Member) begged to second the vote of thanks to Mr. STURGE for his able paper on a subject, which, however dry it might appear to be, was one which in reality involved many considerations of a most interesting and important kind.

He agreed with Mr. RYDE, that the good old Act of Queen Elizabeth was as clear and distinct as it could be and needed no tinkering of any description.

His experience with reference to underwood was, that, unless grown in districts where hop poles or props for mines were required, or unless it was of the kind used for making hoops for barrels and for hurdle making, and such like, it possessed little or no remunerative value, after deducting a small rent for the land, also rates, taxes (and tithes, where payable), and the labour of keeping up the fences, the cost of which was always thrown upon the wood; therefore it was approximately correct, he thought, to represent the value of the underwood as *nil*, unless grown on a soil which had been improved by draining and where there was such a special demand as he had just referred to, or where coals were exceedingly dear.

Mr. C. G. GREY (Member) was of opinion that it would not be well, in discussing this question, to pass over the

part of the Act relating to mines as it was strictly connected with the business of a Surveyor.

He was not quite sure whether he caught Mr. Sturge's meaning with regard to the 7th section. He understood him to say that, where mines were let upon lease under certain conditions, they were rateable on the dues only, and that the machinery and buildings escaped.

Mr. STURGE explained that they were rateable on the dues or royalty, which he treated as the same thing.

Mr. GREY said that the terms were understood to signify the same thing. In the interpretation clause, a "mine" was explained as including "the underground workings and the engines, machinery, workshops, tramways, and other plant and buildings not being dwelling-houses." If this plant and machinery were erected, by the lessor, on the surface, and the mine and machinery were let together, either at a fixed money rent or depending on the amount of minerals raised, a full rent would be paid by those dues, but where a lessor let a mine on lease the common practice was for the lessee to erect all the buildings and machinery, in which case the dues represented the rent of the minerals only.

In this case the lessee was rated in respect not only of the machinery, but also in respect of that which was beneath, including, tram, trucks, and all other underground plant.

Had he been aware that the question would have arisen he would have been able to refer to some cases in point as authorities for what he stated; but the justice of it was clear, because the profit on the machinery and buildings

not being represented in the dues, the lessee, being rated on the full value of the mines, would otherwise escape.

With regard to the term "unimproved land," it was undoubtedly true that a great deal of such land which was planted was not worth more than a few shillings an acre, and was devoted to that purpose in very poor districts because it was literally good for nothing else. The adjoining land, on the other hand, may have been improved to such an extent as to be worth 15s. or more an acre; and it was not fair, therefore, to take the former at the value of the adjacent land. The value of such land was what it would let for in its present state, if there was no trees on it.

Mr. T. SMITH WOOLLEY (Member) said that he did not quite agree with Mr. RYDE or the last speaker as to construing Acts with reference to the supposed intentions of their framers. He thought it better to take the literal rendering of the Act, whether that of Elizabeth, or that of 1874. His belief indeed, was that it was the intention of the legislature in Queen Elizabeth's time, to encourage the growth of timber by relieving it not only from the payment of rates, but from liability to tithes, and the framers of that Act therefore arranged that underwood only should be titheable and rateable. As regarded the Act of 1874, the literal interpretation of the words "natural unimproved state," disposed of the theory that the land was to be valued as if a tenant might "do what he liked with it." He happened to have had under his own notice a case which exactly illustrated his point. Forty years ago there was in the parish in which he lived, a tract of dry, gravelly heath land, worth about half-a-crown an acre. It was broken up and brought into cultivation, becoming worth about 14s. or 15s.

an acre, and remained in that state for eight or ten years. Thirty or forty acres had since been planted, and it was very clear that the sum at which that must be rated, was not the larger sum represented by its value as arable, less interest on the cost of grubbing on reconverting, but the half-a-crown an acre which was its value in its original state.

It was rather interesting to him to note the identity of human nature as displayed by the members of Assessment Committees in the West of England, according to Mr. STURGE's description, and in the parts with which he was more familiar. All Assessment Committees in his country had endeavoured to apply the same principle as that mentioned by Mr. STURGE, which was unquestionably entirely wrong. It had been contested on rather a large scale in two cases within his knowledge. One of these was the case of the Clumber woodlands, heard before the Notts Quarter Sessions, and the other a case in which Lord Westmoreland, the Marquis of Exeter and others were concerned, before the Quarter Sessions for Northamptonshire. He was not himself engaged in the Clumber case, but some well-known members of the Institution gave evidence in it: the result of their labours being to convince the Committee that the assessment was wholly wrong, and it was reduced to about 4s. per acre. In the case in which he was engaged, the result was a reduction from 12s. or 14s. per acre to 6s. or 7s., including the right of sporting, so that, so far as the Midland counties were concerned, he thought that the interpretation of the Act which he contended for was becoming fairly recognised.

Mr. G. D. YEOMAN (Member) asked whether he rightly understood Mr. STURGE to say that, in the case of a wood to

which he referred in his Paper, the overseer had said he would pay the rent which he had assessed it at, if he might have the wood and all that was on the land. This offer, of course, was declined. Mr. RYDE had said that the offer was a fair one, but he thought there must be some mistake, as it would be absurd to suppose that the overseer should have the wood which grew upon the land. One remark he should like to make with reference both to the working of this Act and the old one. As the law stood, any person holding certain qualifications in rural districts was liable to be an overseer, so that the village shoemaker or tailor might be appointed to value the shooting, the woods, mines, and farms of the parish. Nothing could be more absurd than such a state of things. He knew one instance in which the overseer had to value the most impenetrable woods he (Mr. YEOMAN) had ever seen in his life, grown over with thorns, briars, and brambles, and comprising an area of about 100 acres. This man had the misfortune to have a club foot, and said he could not walk through the woods, and put them down, haphazard, at 10s. an acre! The result was an appeal to the assessment committee, who seemed, however, to have their own modes of reasoning, and they agreed with the overseer, and said, "No doubt the wood was worth 10s. an acre." A further appeal to the magistrates was attended with a similar result; and it was only by threatening to take a case to Quarter Sessions, and giving notice of such to the Assessment Committee that they managed to get three qualified valuers down to value the whole district. The result was that, in all cases he might say, the regular valuation was entirely upset. About 500 or 600 acres of wood in some places, and about 2,000 in others, had been reduced from 10s. an acre to 2s.—a somewhat startling alteration.

The vote of thanks having been put and carried unanimously, on the motion of Mr. P. D. TUCKERT the discussion was then adjourned.

AT
THE ORDINARY GENERAL MEETING,

Held on Monday, December 18th, 1876.

THE PRESIDENT IN THE CHAIR.

The discussion on the Paper by Mr. W. STURGE, on the Rating Act of 1874 (37 & 38 Vict., cap. 54), was resumed by—

Mr. P. D. TUCKETT (Member) who said he was sure that the Institution must have felt the highest satisfaction that Mr. STURGE should have prepared so clear and valuable a Paper on this important subject.

It was suggested by a speaker on the last occasion, that the pecuniary considerations involved in these items of assessment were, comparatively, so small, that the local rating authorities were not able to afford the expense of professional assistance, and that, as a consequence, Surveyors had less to do with them than they otherwise might; but he was sorry to say, that there was another and more painful way in which Surveyors were brought face to face with assessments of this class—he referred to the multitude of small cases in which, in their capacity as agents, they were constrained to seek to alter improper assessments of the woods and the sporting rights of properties under their management, and he could only hope that by means of this discussion the intentions of the legislature might be more clearly elucidated, and some approach be made to a settlement of the doubts which had arisen.

He was very glad to hear Mr. WOOLLEY say that in the Midland counties a correct interpretation of the Act was being gradually arrived at; but he was sorry to say that in some important instances he had found the case very much the reverse. For instance, he was agent to the owner of a wood, consisting of 150 acres, the rateable value of which the Assessment Committee considered was properly put at 18s. an acre, although the total nett return from both timber and underwood did not average more than 10s. an acre; and, on his remonstrating with the Surveyor of Taxes for putting the wood in Schedule A, for rent, at £1 an acre, with a further assessment of a rather lower rate under Schedule B, for tenant's profit, he received a letter, maintaining that there could be no hardship in so doing, when land in the parish was let at £2 or £3 an acre,—the fact being that the surrounding farm was let at 32s. an acre, and the tenant was seeking a reduction in rent and threatening to leave. He might mention that a leading member of the Assessment Committee to which he had referred, was in a large way of business as an Auctioneer. In all these cases, the point harped upon was the value of the adjoining land. It would be remembered that the original draft Bill proposed to enact that woods should be rated at the value of the adjoining land. The Bill was materially altered in its passage through Parliament, but this expression appeared to have taken firm root in the minds of the local authorities throughout the country, and it required he found, a good deal of discussion to get rid of it.

He had met with people who contended that what was called the natural state of woodland would be realized if the trees were cut down and the stumps left in the ground, which, however, would certainly not be its natural state. Others again argued, that if it were grubbed, it would be in its natural state, but this seemed a still more strained

interpretation of the phrase. Mr. STURGE's method of comparing such land with a piece of unreclaimed waste which had never borne timber, would, no doubt, lead to a more truthful and logical application of the words of the Act ; but in cases in which he should most desire to apply such a test there happened to be no such pieces of unreclaimed waste with which to institute the comparison ; and if it were to be a mere matter of imagination on the part of Surveyors, he was afraid their opinion would not carry great weight with the assessment authorities.

There were many woods which were the remnants of ancient forests, and which had been left on account of their extreme unfertility, and because the land they occupied was the least worth breaking up : many such pieces of land had remained from time immemorial in wood, and an abundance of examples of the kind might be found in the Buckinghamshire hills. Such lands would seem to be still in its natural state, but if that were so, unless a new principle were introduced (and he thought this would hardly be contended for), of rating them on the total nett produce—in fact making the timber rateable—the inference would be that such ancient woods were practically of no rateable value, because woods of that description never paid a sufficient interest upon the stock of growing timber, without reckoning anything for the rent of the land. He was very much afraid, in spite of what Mr. WOOLLEY had said, that these very difficult words “the natural state of land” would always be a bone of contention until they formed the subject of some decision by the Court of Queen's Bench.

As to the land used for the growth of saleable underwood, Mr. STURGE raised a question which would be very interesting if the assumption with which he started were correct—the interpretation, namely, to be put upon the old law. It was assumed by Mr. STURGE that, as under the Act of

Elizabeth, saleable underwoods were specially rateable, and not merely the land which produced them, it was proper to rate the net proceeds (after making suitable deductions) of the saleable underwood without allowing any interest upon the eight, ten, twelve, or fourteen years' shoots during the time the underwood was maturing—in fact, to rate underwood as a rateable asset and not as a crop belonging to the tenant. Now Mr. RYDE distinctly laid it down, in a calculation which he gave, that interest was to be taken off upon the shoots of the underwood. Mr. STURGE suggested that the present Act, by making rateable the land devoted to the growth of saleable underwood, and altering the law as to the rateability of the underwood itself, had made a change in that respect—so it came to this, that Mr. STURGE and Mr. RYDE perfectly agreed as to the law as it stands, but entirely differed as to what it was before. He did not wish to contend with Mr. RYDE, as to what the strict law had been, but as regarded the ordinary practice, he thought that Mr. STURGE was right, and that from the price at which underwood only was rated throughout the country, there could have been no deduction for interest in those cases that had come before him; and if that were so, Mr. STURGE had done good service to those who owned such property, by calling attention to this alleged change in the law, which might probably reduce the rateable value of saleable underwood by three-fourths.

The point on which he particularly wished to say a few words was as to the rating of sporting rights. It seemed to him that there was a deduction to be drawn with reference to this point, which had not been quite so prominently stated as he should like it to be. The Act appeared to him to contemplate three distinct cases:—the *first* was, where the occupier had the sporting rights, and that case the Act did not interfere with; *secondly*, where

the landlord let the land separately, and retained the sporting rights himself; and, *thirdly*, where they were let to a third party. As regarded the first or second cases the only change in the law which had taken place as to the rating of land and sporting rights together was, that the tenant was enabled to shift a small share of his rates on to the landlord's shoulders, because the rent at which any land or farm could reasonably be expected to let, had always been hitherto that rent which it could reasonably be expected to let at without reservations; in other words, as if the tenant had all the rights and privileges which naturally pertained to the occupation. He did not mean, of course, as if the tenant of land had the right of shooting over the entire estate, but assuming land let in a natural way, without any reservation, it must be imagined that the landlord shoots over the covers in hand, and that the tenant has an unrestricted right of shooting over the lands around and between the covers; and that would come to this, in many cases, that the land was to be assessed as though preservation of game were simply impossible. Now Mr. RYDE pointed out that, after the rating principle of the Act of Elizabeth had remained unaltered for some 300 years, (so far that every kind of property rateable at all was always rateable at what it might reasonably be expected to let for,) this Act had, for the first time, introduced an innovation in the very principle of rating, both as to mines let on lease and as to sporting rights retained by the landlord. If let to a stranger, the measure of the value of the sporting right was just what that sporting right was worth to the man who hired it (it might be over woods and farms in the occupation of various people); but if the landlord retained the shooting, a totally different principle was applied, viz., that the point to be considered was not what it was worth to the landlord, or whether it was good or bad shooting, but simply how much less the farm was worth



with the reservation than it would be without it—in other words, what more rent the tenant would have given if he had had the right of shooting; and in doing this it was not to be considered that the tenant would have had the same right of sporting as a landlord, because he was only to be assumed to be able to take game and rabbits on the land itself concerned, and not to interfere with adjoining woods or wood hedges, unless let to him. This might form a very important distinction; for, in certain cases, he had been told by farmers whose crops were suffering, that it was quite useless to try to destroy rabbits on their land if they might not touch the wood hedges where the rabbits burrowed. Whether the game damage proved less or more than the value of the shooting, it was clear that if a man let his shooting it was to be rated on a different principle to that which would apply if he retained it. He was glad to call attention to this point, because he had noticed that in many parishes in the country it was usual to agree on a uniform rate whether the right were let or retained by the landlord, and in many cases he thought injustice would be done if such a practice were adopted; because in such a case as that of good partridge-shooting, if each tenant had the shooting on his own farm only, neither of them would make much by it, whilst if the shooting were reserved the game damage to the tenant would be but trifling; so that the shootings ought to be rated to the landlord at very little; but if let to a stranger, it would have a very considerable value, and should be rated accordingly. This brought him back for a moment to the question of woods; because if anything was to be added for sporting rights in rating woods, it should be remembered that where the surrounding land was let away the shooting over the wood alone, without such land, would be almost valueless.

He would venture in connection with this subject, to

call attention to a kindred one—he alluded to the returns for property tax issued last summer. There had been considerable trouble in filling up the elaborate returns as to woods and cottages in the hands of clients. In addition to these returns the surveyors of taxes had before them the gross estimated rentals from the valuation lists, but the surveyors of taxes in many instances, notwithstanding these two sources of information before them, made assessments which, so far as could be judged, rested on no evidence whatever, and exceeded both one and the other of these data. Notice of appeal was sent to the owners or agents, and although generally dated about a fortnight before the appeal day, they might think themselves fortunate if they received them on the appeal day, or the day before. Even if the time rendered it possible to attend, very often the distance would not; and in some cases the travelling expenses came to more than the matter was worth, and there was no practical remedy. This practice, moreover, was very unnecessary, for rural assessment committees were very careful to assess woods and cottages at their fullest value, and perhaps a little more, without any stimulus; and this excessive assessment was the more vexatious, inasmuch as great trouble had been given by asking for returns which were afterwards entirely ignored. The Valuation Bill of last year which was discussed by the Institution, and was withdrawn, contained a provision which would have stopped this inconvenience, as it proposed to make the gross estimated rental conclusive; but he remembered that many members objected to that Bill on the ground that it would give the surveyor of taxes an undue voice in fixing the gross estimated rental.

The HONORARY SECRETARY read a communication received from Mr. J. CLUTTON, who (after expressing his

regret at not being able to attend the meeting) said that it appeared to him that there were two questions to be considered: first, were lands growing underwood to be rated as if the crop were cut or upon an average of growths. For instance, a tenant takes 100 acres of underwood which have been just cut, or what was the same thing in fact, pays for the growing crop on entry. The underwood was marketable at 10 years' growth; was an allowance to be made for interest of money upon rent, rates, and taxes for the whole period of 10 years, or (where a landlord holds the same 100 acres in hand rateable as before) was it to be assumed that one-tenth was marketable annually, and no allowance to be made for interest? He thought it should be taken as though the whole had been cut or paid for. In fact, in the southern counties, the tenants entering on a farm paid for all underwoods from one year's growth upwards.

Mr. J. SHAW (Member) said that he had read with very great pleasure the paper prepared by Mr. STURGE. He did not agree with Mr. STURGE, however, as to the old way of assessing coppice woods, nor was he quite clear as to his view of the rating of mines under the Act. In other respects, he thought that he had stated the principles of the Act very clearly and concisely. The only questions which appeared to him to arise with reference to the rating of woods, were as to the value of the land planted, if let and occupied in its natural and unimproved state, and the value of the land if let and occupied for the growth of saleable underwood. With reference to the latter, the value would depend upon situation and circumstances, and the rent or annual value of the crop, and he did not think that much difference of opinion would arise on that point; but with reference to the former, many different opinions existed. For his own part, he had adopted the plan laid down by

Mr. STURGE, whose principle was that the land was not to be rated on its improved value, but on what it would be worth if continued to be occupied in its natural and unimproved state. In some cases, the land planted was very poor and almost valueless, and in other cases land was very good in its natural and unimproved state. He knew of an extensive common in Nottinghamshire where land in its natural and unimproved state was now worth 20s. to 25s. an acre, and he did not suppose it would be worth much more if brought into cultivation.

As to the rating of game, where severed from the occupation but not let, there should, he thought, be added to the holding the fair annual value which it would be worth to the tenant, or if let. For his own part, he did not see that it mattered whether it was in the hands of the landowner or let to a tenant.

Manors when let in his neighbourhood, averaged from 9*d.* to 1*s.* an acre, the tenant bearing all expenses, and that was generally the amount of the assessment.

The rating of mines had been mentioned. The Act included all mines not mentioned in the Act of Elizabeth, but special power was given under section 7, with regard to the rating of tin, lead, or copper mines. There seemed to be a little difficulty in arriving at the exact meaning of the Act, and Mr. STURGE appeared to think that a mine occupied by the owner was on a different footing to one let on lease; but he (Mr. SHAW) thought, whether occupied by the owner or let on lease, it should be rated on the same principle.

With regard to the working of the Act in his own district, he would like to mention a few important cases in which he had been personally concerned. In one extensive estate there were moors which, before the passing of the Act of 1874, were rated at 2*s.* 6*d.* an acre, and were

now raised by the Assessment Committee to 3s. 6d., and woods at about the same sum, including game, which were rated at about 1s. an acre. He thought the assessment too high, but as there was a friendly spirit shown, he had not appealed, at present, and was still paying on that assessment. There were also about three miles of fishery on the same estate, rated as follows, after an appeal to the Assessment Committee,—£10 a mile for half the river where preserved on both sides; £5 a mile where preserved on one side only; and £2 a mile where not preserved at all.

The DUKE OF RUTLAND was the owner of extensive moors and woodlands in Derbyshire, situated in several unions. In order to test the assessments a specimen case was taken—that of the Chesterfield Union. The Assessment Committee in that union first rated the woods at 14s. 3d. per acre, and the moors at 5s. There was no underwood of any value, and the land was worth more as uncultivated land than for the underwood grown upon it. In order to save expense, he advised a proposition to be made to the Assessment Committee to rate the woodland at 6s. 6d. and the moors at 3s. 6d. per acre all round. The Assessment Committee agreed to rate the woods at 6s. 6d., but declined to reduce the moors below 5s. The case was then taken to the Quarter Sessions at Derby, in July last, and the whole question was fought on the merits.

His valuation of the moors was, as to part, 2s. 6d., and as to a smaller part (a mere bog) 1s. 10d. per acre, including game, which was in the hands of the owner, and valued at 6d. and 1s. an acre. The Sessions fixed the assessment of the moors at 3s. all round. He valued part of the woods at 4s. 3d. and part at 6s. an acre, including game at 9d. The Court reduced the assessment of the woods to 4s. in one case, and 6s. in the other, and this, of course, was considered a very fair and satisfactory result.

Immediately afterwards, he was engaged in the Clumber and other cases, mentioned by Mr. WOOLLEY at the last meeting. The rating in Clumber had been reduced by the Committee to an average of 6s. 9d. an acre, exclusive of game, which was let. Some land—a part of Sherwood Forest—there was no difficulty in estimating the value of, in its natural unimproved state, and the Court of Quarter Sessions was satisfied on all points. The Court of Quarter Sessions at Retford fixed the assessment at 4s. 2½d. gross, and 4s. nett all round.

In Worksop Manor, his valuation was 4s. 5d. gross and 4s. 3d. nett; the Court fixed the assessment at 4s. 8d. gross and 4s. 5d. nett: the game was let in this case also. In Osberton, a similar reduction was made, and the game, which was in the hands of the owner, was estimated at 9d. per acre.

He might state that he had, at the present time, an Appeal at the next Derbyshire Sessions, in January, in the case of woods which the Assessment Committee had assessed all round at 25s. per acre, but which were not worth anything like that sum. He went before the Committee to ask for a reduction, and pointed out what the property was worth, and they were only liberal enough to allow him a reduction of 5 per cent. from the gross to rateable value, instead of about 2 per cent. as in the assessment, and declined to make any further reduction. He entertained very little doubt as to the result of the Appeal; but it would take some time before Assessment Committees thoroughly understood the principles of the Act; he hoped, however, that the discussion of the measure by this Institution, together with what was taking place in various parts of the country, would, in the end, leave the Act thoroughly and perfectly understood.

Mr. W. BROWN (Member) said that the subject under

discussion was most interesting, and was one which had given him a good deal of trouble. He proposed, in the few observations which he should make, to place the information gleaned from his experience of the working of the new Act, at the disposal of his fellow-members.

No allusion was made by Mr. STURGE to the instructions, or explanatory statement, issued by the Local Government Board to the Assessment Committees throughout the kingdom. In these instructions, the Board tried to elucidate the meaning of the words, "in its natural and unimproved state," pointing out that it would be "the duty of the Assessment Committee to deal with the land as if it were divested of timber, or wood of any description, and to determine its value, without taking into account any improvements which had been made, or of which the land might be capable." The circular went on to say (referring to the Act)—"the words used, are as if the land, instead of being a plantation, or a wood, were let and *occupied* in its natural and unimproved state, and the word 'occupied,' was introduced in order to show clearly, that the capabilities of the land, for improvement, were to be excluded from consideration, in estimating the rent at which it might, reasonably, be expected to let, from year to year," and that "the land was to be valued as if it would continue to be occupied in its natural state, without any expenditure of capital in its improvement, or in other words, as if it were waste land." Notwithstanding that very clear and explicit instruction to Assessment Committees, he believed, as a rule, they took no more notice of it than of so much waste paper, putting woodlands at prices which could not be tolerated.

The first case in which he was engaged, was in the Hemel Hempstead union. In that union, the general body of landowners appealed against an assessment of, from 15*s.* to 20*s.* an acre, but so far as the Assessment Committee were

concerned, their appeals were in vain; and they gave notice, therefore, of appeal to the Sessions. Their estimate of the value, in accordance with the Act, was about 10s. an acre, and a shilling for the sporting rights; and, at last, rather than incur the risk of going before the Quarter Sessions, the Committee reduced the assessment to that amount, and the neighbouring unions having followed their example, the whole question had now been settled on an uniform basis.

The next case which came under his observation was in the High Wycombe union. Two gentlemen appealed, one, Mr. ELEAMS, and the other the Hon. Member for Marlow. In the parish of Great Marlow, the Assessment Committee put the whole of the woods at £1 an acre. Mr. ELEAMS' valuation included something like 404 acres, and they managed to get the assessment to £404. He (Mr. BROWN) and Mr. HUSSEY were engaged on the part of the appellants, and a member of the Institution, assisted by a local Surveyor, on behalf of the union: these latter gentlemen made the same mistake which had been made by many Assessment Committees—they took the value of the land as being what it would produce provided it were grubbed and brought into culture. No one, he thought, would doubt the fallacy of that method of estimating the value. The evidence which he (Mr. BROWN) gave, and which he was happy to say was confirmed by the Court, was that the Beech Woods were worth, in their natural and unimproved state, from 8s. to 10s. or 11s. an acre. and the sporting 1s. an acre. He also had the question of underwood to consider, and his estimate of its value, although arrived at by somewhat different means, gave about the same result.

In connection with this assessment a question arose which had not been touched upon by Mr. STURGE, or by any other gentleman, but which, in his opinion, was a

question open to great argument—he alluded to plantations. Now the plantations with which he had to deal under that Appeal were chiefly made from good grass land, actually used as such within the lifetime of many men working in the parish; so that, in reality, according to the argument, it became very much reduced in value by planting. Now he was not prepared to take the same view with reference to plantations as to natural woods, for, in the former case, the natural and unimproved state of the land as old sward land was of much higher value than would be the case if that original condition were barren waste.

If the portions of the park were letting, before planting, as they did, at from 45s. to 50s. an acre, he failed to see that the land was not worth more than an ordinary wood. He was called upon in cross-examination to state how he defined this difficult question of “natural and unimproved state,” and he was enabled to give an explanation which, he thought, the Court was satisfied with, viz., that in the neighbourhood of these woods there were many downs and sheep walks which had never been in any way interfered with, and he knew cases in their immediate neighbourhood where those sheep walks or downs had been assessed at from 7s. to 10s. an acre. So far, he obtained the ear of the Court, and they confirmed the evidence he gave. He was called on the next day, in the case of the parish of Great Marlow, and Mr. WETHERED. In this instance the land was of a different description. All that could with any profit be cultivated in their immediate neighbourhood had been cultivated, but the woods allowed to remain were chiefly, if not wholly, on the sides of chalky banks, producing the worst description of beech timber that any one could imagine. His valuation in the case was as low as 5s. an acre, and varied from that sum up to 8s., and the Court also confirmed those figures to a penny. At the conclusion of this case the Assessment

Committee protested against being made to pay costs, but the Court ordered them to do so, to their very great disgust; and the ruling of the Court in that case had been acted on in the greater part of the county of Bucks.

In a third case he represented the opposite interest. The subject of assessment was the DUKE OF BUCKINGHAM's woods on the Wotton Estate, which were of an entirely different character to those he had been describing. He found that the Assessment Committee had put some at £1, and some at 15s. an acre, which the Duke's agents thought too much. The Assessment Committee of the Aylesbury union (which was a very important one) desired him to report upon them. In this case the question of plantations again came before him, some of the land which the Duke had planted having previously been useful arable land, letting at from 25s. to 30s. an acre. This plantation was something better than was usually met with, with grass drives round it and through it; and he advised the Assessment Committee to put it at 20s. an acre. The remainder of the Wotton woods were used by the previous Duke as preserves, and most of them were planted with blackthorn, which produced a very poor return,—in fact he scarcely knew whether it would have paid more than a trifle beyond the actual expenses. The woods were chiefly open underwoods of the worst character and least possible annual value, and would let for sporting purposes for quite as much as for any other purpose.

He advised the Committee to deal with the case by putting certain plantations and shrubberies as appendages to the mansion, and to assess the remainder, including sporting rights, at 10s. an acre. He hoped to hear some expression of opinion from Mr. STURGE or some other gentleman with reference to the assessment of plantations, as the subject involved special considerations and was not so clear as it

might be, and it was difficult to decide what their "natural and unimproved state" might be. To take an instance within his own experience: one of his employers, not long since, built a good mansion, and as a matter of necessity he had to devote good arable land, assessed to the poor rates at £2 an acre to plantation purposes, in order to make, as it were, an ornament to the estate. The land thus taken had been arable land for hundreds of years. The question he should like answered was, how was it to be assessed in its present condition?

Mr. ARUNDEL ROGERS (Associate) said that the Act of 1874 was certainly passed more with reference to mines than to any other subject of rating, and had it not been for the proposed exemptions which some mines had previously claimed, there would, probably, have been no new Rating Act passed at all. Be that as it might, the principal alteration effected by the new law of rating had reference more to mines than to any other classes of property. It was impossible to alter the law of rating in one respect, without affecting the law as regarded other properties. In order to understand the matter properly, it was necessary to consider the origin of the law in the first instance. Under the Act of Elizabeth, every inhabitant, as well as every occupier of land and houses, coal mines and saleable underwoods, was liable to a rate for the relief of the poor. The principle of that statute was twofold; viz., to tax certain property specified in the Act, as well as every parishioner. It would, therefore, be observed that, although every parishioner was to be taxed, all real property was not rateable under the statute; and, as was well known to all land surveyors, occupancy was the test of rating, and no property, he believed, before or since, up to the passing of the Rating Act of 1874,

was made rateable, except there was occupancy, and that occupancy exclusive occupancy, *i.e.*, if any one interfered with the occupancy, no rate was liable to be made on that property. He quite agreed with Mr. RYDE (page 34), that the Act of Elizabeth was a sound piece of legislation, and admirably adapted to the requirements of those days. He could hardly, however, agree with Mr. RYDE, that two clauses would have been sufficient to put in an amendatory Act, although a few other provisions might have been sufficient, still it could hardly be doubted that the exemption of property from taxation, under the statute of Elizabeth, was hardly equitable, although there was reason, at that time, for particular exemptions, supposed to be sanctioned by that statute. For instance, one would hardly expect to have found, under that statute, as under the new law, any provision as to plantations, and rights of sporting. As to plantations, it was not necessary to make a rate in respect of them. Plantations had increased in value since those days, and as for sporting, he supposed it would have been thought almost like the act of a madman, to restrict the wild sport, which was looked on, to a great extent, as the common right of everybody. As respected mines, other than coal mines, the omission from the Act was sufficiently intelligible, from the fact that, in those days, coal—of all the minerals—was the only mineral to be found close to the surface in sufficient quantities to be raised with great exactness and at a trifling cost; and that being the case, it was easy to ascertain what coal existed, and was raised, and to tax it accordingly. This, as he had said, was not the case with any other minerals, and, consequently, to put a tax upon them would have been unjust. But now, coal was not raised as in those days, except in districts still unexplored. It had to be raised from great

depths, and at a great cost, and, in some districts, at great risk, and the labour of the miner, and the cost of production, was proportionately greater.

It was, therefore, only just that other mines should become rateable. He did not wish, however, to be understood to state all other mines were necessarily excluded from the statute. On the contrary, he believed that, if that statute were now to be reviewed for the first time, it would, probably, be held not to exclude any mine, and that coal mines were mentioned only by way of example, and not of exclusion; and, in this view of the statute, he was supported by the late Chief Justice Tindal, Lord Ellenborough, and the present Lord Chelmsford, in three very important cases, which really concerned the whole law of rating, viz.: *Crease v. Sawle*, 11, L.J.M.C., 62; (2) *R. v. Baptist Mill, Co., M. & T.*, 517; and *Crawshay v. Misgam*, L.R. 5, H.L. 318. But another reason why an alteration in the law, especially as to mines, became necessary, was, he was afraid, owing more to the ingenuity of lawyers in the past, than to the interested designs of Surveyors. For instance, it had been decided, that although coal mines were rateable, that if coal and iron were found mixed, and both were rated together, the rate was bad (*Reg. v. Cunningham*, 5 East 478). Again, although all mines under the old law, except coal mines, were exempted, quarries were not exempted, and all minerals, whatever they were, which were raised from quarries, were held to be rateable, although if raised from mines they were not. This was another reason for the alteration in the law. Now, as to tin, copper, or lead mines, tolls or dues reserved in kind in respect of all mines were rateable, although tolls or dues reserved in money were not rateable. Again, reservations of the ore in a smelted state were not rateable. If in a state fit to be smelted, it was rateable. These

mistakes were, he thought, sufficient to show that an alteration of the law was necessary, and not only necessary but really absolutely called for, so as to put an end to these anomalies. He agreed with Mr. STURGE in his interpretation of the new statute so far as respected the question of plantations and underwoods, and also as respected the rights of sporting—unless he intended, at page 28, to mix up the question of rating with the rights of the landlord, when he referred to the landlord keeping up an indefinite head of game without paying compensation to the tenant.

He thought the Institution was very much indebted to Mr. STURGE for his endeavour to clear up the mysteries of the new Act, as affecting the law of rating of mines. It was stated however by him, at page 30, that he did not understand why there were special provisions in the Act in respect of copper and lead mines. Perhaps, he might be permitted to say that there were several reasons for doing so. In the first place, as he had said before, they were exempted from all taxation whatever, and therefore it was hardly feasible to pass a law for the special rating of this property unless there were some special provisions in respect of them. Mines of this class, moreover, were very precarious. A vein might be discovered and things progress favourably at first and have every appearance of going on prosperously, when all at once the vein suddenly ceases, after costly machinery has been erected, and great loss possibly ensues. This was a reason why some special provisions were required with reference to these mines. But there was also the further reason that these mines in many districts of England—Cornwall, Devon, and other counties—were worked where peculiar customs had long existed with reference to machinery and the fixtures belonging to the same, and it was really necessary to make some special

provisions for the working of these mines in order to deal with them in a manner suitable to the district.

But the main difficulty raised by Mr. STURGE (page 31), had reference to the rating of engines, machinery, and buildings belonging to the mines when the mines were worked by the owner himself. It very rarely happened that the mines were worked by the owners themselves. He was not aware, at this moment, of a single mine in the counties to which he had referred where anything like what was called machinery, was erected for them. They were worked by people, under agreement or lease—third parties—but, he might say, never by the owners of the land. But, perhaps, on a careful review of the old law, in conjunction with the Rating Act of 1874, Members might come to the conclusion that there was not much difficulty about the question of rating the machinery and fixtures belonging to these mines, whether the mine was worked by the owner or leased or let by the year to a stranger. The principle of rating these mines was occupancy,—exclusive occupancy,—and it was decided long before the passing of the new Act that, whoever was in exclusive possession of and occupied the machinery and tackle of a mine, was liable to be rated for them, and the owner would now, probably, be liable to be rated under the old law of occupancy, even if he could claim exemption under the new statute; but he had not looked sufficiently minutely into the question to give a legal opinion upon it. He should prefer giving some references to the authorities, and directing attention to the recent case of *Kitton and the Liskeard Union*, which was decided in November, 1874, after the passing of the new Rating Act, but before it came into operation, and which was, therefore, rather an important case in deciding when the buildings and machinery of a mine were rateable.

He might, perhaps, refer to the 13th Section of the new Act, which, he thought, was not mentioned by Mr. STURGE, which provided that nothing in that Act was to apply to a mine of which the royalty or dues were, for the time being, wholly reserved in kind, or to the owner or occupier thereof; so that the old law of rating these mines specially would still have to be largely consulted. He need hardly remind the Members that where the poor rates were payable upon this character of property, all other rates were payable, such as the Police rate, Highway rate, County rate, and other small rates. Although he thought that the Rating Act of 1874 might have been much more simple and intelligible, he had no doubt there were reasons for the peculiar wording of some of its clauses, which did not at first sight appear.

Mr. W. STURGE (Vice President), who was unable to be present, sent a written communication, in which, after apologizing for his absence, he said that he would refer, in the first place, to the remarks of Mr. RYDE on his interpretation of the words of the Act, as to the rating of land used as a plantation or a wood, as if it "were let and occupied in its natural and unimproved state." It was said by Mr. RYDE that the overseer, referred to in his Paper, who offered to take the woodland at a certain rent, "to do what he liked with it," was not far wrong. If the tenant could do what he liked with the land, he could improve and cultivate it. But the words of the Act were, that the land should be valued as if it were let and *occupied* in its natural and unimproved state—in other words, as if it were common or waste land used merely as a run for young cattle and sheep. Although common or waste land might be externally fenced by the fences of the adjoining inclosures, it would not be sub-divided by the fences necessary for cultivation, and might therefore be properly valued as unfenced.

Next, as to the valuation "of land used for the growth of saleable underwood."

He had stated in his Paper that under the Act of Elizabeth the underwood was rateable; but that under the new Act this provision was repealed, and the value of the land was to be estimated as if it were let for that purpose. He further stated that the proper way to value the underwood for rating under the old Act was to divide the nett proceeds by the number of years' growth. Mr. RYDE had objected to this mode of estimating the value that the amount must be reduced by the compound interest accruing on the annual expenses incurred before the crop arrived at maturity. He would be perfectly right in this view if the woodland let were bare land just cleared of its crop of underwood, and which would produce no more until the next crop arrived at maturity. But he (Mr. STURGE) assumed the case of a wood in a regular course of cutting—say, 1-14th part in each year—and let with its growing crop of underwood upon it; in this case the compound interest on the annual expenses would not accrue, because there would be a crop of wood each year to meet them. It must be borne in mind that the price which a wood-dealer paid for underwood was not the gross value of the wood, but the wholesale price which he could afford to pay, allowing him a sufficient margin of profit by retail sale. Take the annual purchase-money, deduct the annual expenses, and divide the difference by the number of years' growth, and a rent was arrived at which a tenant could afford to give for the land, including the growing crop of wood, and the tenant would make his profit by the retail sale.

But, under the new Act, the underwood itself had ceased to be rateable, and the value was to be estimated as if the land were let for the purpose of growing underwood. He contended that, under the new Act, the crop of wood was

not rateable, and that, in estimating the value for rating, the tenant was entitled to an additional deduction for interest on the capital, which he must, on entry, invest in the purchase of the growing crop of wood.

He had heard the suggestion that the growing shoots of wood continued to be rateable under the new Act; but he contended that they were no more rateable than a crop of corn. In the case of a wood, as in the case of a field, the value of the land was to be estimated as if it were let for the purpose of growing the crop; and although the gross value of the crop was the first element in an estimate of the letting value, it must be reduced by the expense of cultivation, the tithe and taxes, and the tenant's profit, in order to arrive at the rent. If a tenant took a wood with the crop just cut, he must cultivate it for as many years as were required to bring the next crop to maturity; if, when the crop was half grown, he gave up his tenancy, he expected his successor to repay him the expense he had incurred in the cultivation of the half grown crop; in other words, to take it at a valuation, and the tenant's profit on the capital thus invested was a deduction to be made before the rental value could be ascertained.

In short, the difference between the old Act and the new Act might be thus stated: under the old Act, the land was supposed to be let with the growing crop upon it, and under the new Act, the land was supposed to be let as bare land.

Mr. R. F. STURGE (Member) regretted that his brother was not able to be present. and trusted that the foregoing observations which had been read by him, would be accepted, under the circumstances, and he now proposed to offer a few remarks on his own account.

Reference had been made by Mr. BROWN, to the rating

of new plantations, and he might mention a case of the kind which happened to have come under his own notice. On an estate with which he had to do, the owner had, perhaps injudiciously, planted some very good pasture land, worth—on an average—about 40s. an acre. The overseer of the parish, reasoning on that basis, rated the plantations at 40s. an acre. He (Mr. STURGE) felt it to be his duty to appeal to the Assessment Committee against that rate, and urged that, although it was a fact that the plantations were of recent formation, and the land, in its previous state, was worth the rate, the circumstance could not be taken into account, in rating plantations under the new Act—in fact, that plantations must be taken as such, under the Act, and rated accordingly; that all plantations, as the name implied, were planted at some time or other, and that to rate all plantations on such a principle would not only lead to great confusion, but would be virtually impossible. The Assessment Committee, although thinking it rather a hard case, could not but coincide with his view to a considerable extent, and reduced the rate from 40s. to 25s. He had expressed his willingness to pay 20s., and, therefore, on the whole, he felt pretty well satisfied with the result.

He might perhaps also mention, in connection with the subject, and as confirmatory of what he had expressed, that after the passing of this Act, a conference of magistrates and overseers, representing the County Rate Committee and the several Union Assessment Committees, was held in the county of Somerset to discuss the Act, and to endeavour to lay down the principles on which it should be carried out, and these particular cases of new plantations were referred to at that conference. The Chairman of the conference remarked, with reference to the rating of plantations, that their value was to be estimated as if

the land, instead of being plantation or wood, were let and occupied in its natural, unimproved state, without reference to the surrounding land,—as unplanted and unimproved, and, in fact, simply waste land. One of the delegates observed that when land worth, say, 40s. an acre was planted, the parish, according to the foregoing theory, would lose the difference between the old and the new rateable value ; but the reply was that it was necessary to be guided by the Act of Parliament, that cases were very rare of such land being converted into plantations, and that the law, in providing for the many, overlooked such exceptional cases. That, he (Mr. STURGE) thought to be a just view of the matter.

Reference had been made to a circular issued by the Local Government Board, which had certainly given some valuable hints on the application of this Act, and appeared to give a correct and reasonable interpretation of the difficult phrase “natural and unimproved state,” and which was now generally understood to mean that the land was to be valued as if it were waste land.

In mountainous or hilly districts, there was really very little practical difficulty in judging what this “natural and unimproved” state would be, because there generally happened to be in the neighbourhood some hill side land which remained in its natural and unimproved state, and so formed a very good index of the value of the woodland adjoining. In highly cultivated districts, on the contrary, there was more difficulty in arriving at the value, for obvious reasons.

The mode of rating saleable underwood had been so thoroughly discussed that he would only add a remark or two with reference to it. He confessed that he felt at first some doubt whether the principle for which his brother contended, in his Paper, was correct ; but, after consideration, he had come to share his brother’s opinion. The case

of underwoods was peculiar, inasmuch as there was nothing analogous to them. A crop of wood could not be compared with a crop of corn; neither was it analogous to a crop of grass, of orchard fruit, or any other crop yielding an annual produce, the crop of underwood requiring several years to arrive at maturity.

The question might, he thought, be simplified. Of course, the practice was, where there was a large extent of underwood, whether occupied by the owner himself or let, to cut a portion every year, so that there should be an annual return; but this, it appeared to him, was a mere matter of convenience, and did not really affect the principle, which would, as he had said, be simplified by assuming a small portion of wood—say ten or twelve acres,—to be cut at one fall. Assuming that the landlord had the piece of wood in his own occupation, and decided to let it, he would probably take the opportunity of doing so immediately after the wood was cut and sold, leaving it bare of any crop. In that case, it was obvious that the tenant would not obtain any return until the whole of the wood arrived at maturity, and the figures given by Mr. RYDE, at the last meeting, would then apply. But assume that, instead of taking this course, the owner let the wood with say, a half-grown crop upon it, he would then say to the tenant, “You must pay me for the crop of wood on this land, otherwise I shall get nothing for all these years during which the crop has been growing,”—which meant, in fact, that the tenant should take to the crop at a valuation, of course with the stipulation that he should be similarly paid on quitting. In both cases the annual value of the wood was reduced to very little. He feared, however, that it would be found difficult to convince Assessment Committees of the correctness of the principle contended for.

The rating of sporting rights certainly presented some

complicated features; but, seeing that the amount involved was very trifling, it seemed to him that the only practicable mode was to take some rate per acre, according to the value of the sporting, as had been done by most Assessment Committees and Surveyors—in fact, to take a short cut to the value without going into very minute calculations.

THE PRESIDENT said that, at so late an hour of the evening, he should occupy a very short time with observations on the excellent discussions which had taken place.

It was very satisfactory to find, notwithstanding any efforts Assessment Committees may have made to charge too highly in various parts of the country, that the Surveyors in such parts, had been able to restrain them, and to bring the assessments down, nearly or quite, to the figures which the Surveyors had considered to be just and fair.

It was perfectly true, as stated by Mr. ARUNDEL ROGERS, that occupancy was the foundation on which every kind of assessment rested; but it was true also that the charge rested entirely on the value of the occupancy. The sum which was intended to be assessed in each case was the annual sum which an occupant would be content to pay to the owner. That sum had been, and was, at the present time, the exact measure of the charge on which each person was to be assessed; and, if that simple fact were kept in view, he thought it would meet a considerable number of the difficulties which had been suggested.

The principle of occupancy spoke for itself in each of the three portions of the subject which had been under discussion, but came out with special distinctness in that portion with which he was a good deal concerned—the case of mines. If the mines and the

machinery and conveniences of all kinds necessary for the effective working were held by an occupier, he would pay the owner just such a sum as, after repaying himself a fair and proper return on his capital, he could afford to pay, and whether it was called "dues," or anything else, it came to exactly the same amount. He could not afford to pay more, and the owner would take care that he did not pay much less. If he could pay £1,500 per annum, whether he paid £1,000 per annum for the ironstone and coal, and £500 for the use of the machinery, or whether he paid £1,500 for the whole, he was equally to be assessed on the £1,500.

It would be found, in every case, that the sum which the occupant could afford to pay to the owner, was the gross sum which ought to be charged on the face of the assessment.

The Meeting then adjourned.

RIPARIAN RIGHTS.

By WILLIAM THACKERAY MARRIOTT, ASSOCIATE.

*Read at the Ordinary General Meeting of the INSTITUTION OF SURVEYORS,
January 15th, 1877.*

THE PRESIDENT IN THE CHAIR.

RIPARIAN rights, literally taken, are rights connected with or arising from the banks of streams. A stream, in law, is defined as water running through a defined channel, or a channel with defined banks. Land abutting on a stream is called riparian land, and the owners riparian owners.

If the stream be a natural one, certain rights are held by law to be incident to the ownership of lands abutting on the stream. These are rights to be exercised on or over the area of the riparian lands, and are called riparian rights.

A natural stream consists of a current of water which man has not formed nor put in motion, flowing between banks which man has not made. When the stream is not natural but artificial, similar rights may be acquired by riparian owners, but these are properly easements. Easements may be created in both natural and artificial streams, but the term riparian rights is properly reserved for rights acquired in virtue of riparian lands over a natural stream, and it will be seen that some important differences exist between riparian rights and the easements similar to them.

Riparian rights are of three kinds—1st, those which have relation to the flow of water ; 2ndly, those which have

relation to purity of water ; 3rdly, those which have relation to the taking of water for use.

As these rights have to be exercised within the area of the riparian lands in respect of which they have origin, it may clear the ground to stop here to ascertain what lands are riparian, what is their boundary streamwards, and at what distance, if any, from the stream they cease to be riparian.

The boundary of riparian land on the stream side is well settled to coincide with the medium filum or thread of the stream (1 Mac. H.L.C. 389), so that each riparian owner owns an equal share of the bed of the stream in proportion to his line on the margin of the stream, together with that portion of the bed of the stream which lies opposite to, in front of, or adjacent to, his upland ; and this, in the absence of any controlling grant, will be best defined by straight lines at right angles to his upland, which will in general be the shortest and most direct lines to the thread of the river.

At what distance, then, do lands cease to be riparian ? It would appear that, according to English law, distance is not an element in determining the area of riparian rights. It is certain that the owner of a close, A, abutting on the river can use his riparian rights, within limits hereafter to be defined ; also that if he grant away that part of close A, which does not abut on the stream, its character of riparian land is destroyed, and the grantee does not become entitled to riparian rights. If the owner of close A acquires close B, abutting on close A, but not on the stream, it would appear that he can use his rights for the benefit of close B, as well as close A, but how far this process may be extended, depends on the circumstances of each case, as will be seen when we come to deal with the exercise of the rights

In one sense, however, lands which are not riparian may enjoy riparian rights, and that is when a riparian owner has granted his rights to some one not a riparian owner. In such a case, the grantee can only have a remedy against his grantor, and not against the other owners, if there be any disturbance of the grantee's right.

The boundaries of a riparian owner being thus ascertained, what may he do within them, or what are his rights? First, as to the bed of the stream: Though he has property in the soil to the middle of the stream, he may not use the alveus or bed in such a manner as to interfere with the natural flow of the water, or to affect the interest of riparian proprietors in the stream. He may not, for instance, build a boat-house, if he thereby obstructs the flow of the stream. Such an act is an encroachment which adjacent proprietors have a right to have removed. He may protect his property from the invasion of the water by building a bulwark *ripæ municulæ causâ*, but even in this necessary defence he must not conduct his operations so as to do any actual injury to the property on the other side of the river (*Beckett v. Morris*, L.R. 1, H.L., Sc. Ap. 47; *Attorney-General v. Lonsdale*, L.R. 799, 357), or his neighbours (*Rex. v. Trafford*, 1 Brad. 887.)

It is necessary, in considering the extent to which a riparian owner is justified in exercising his rights, to consider first the relation in which he stands to other riparian owners.

Every riparian owner, in virtue of his ownership of the moiety of the soil of the stream is entitled to the user of the water flowing in the stream. There can be no separate ownership of the water, for, being a moving and a passing body, there can be no property in it. Each owner, therefore, is entitled to the whole bulk of the stream *per my et per tout*. Each owner having a right to use it, all have an

equal right, and therefore no one of them can make such a use of it as will prevent any of the others from having an equal use of the stream when it reaches them.

Each owner has a natural right to have the stream flow in its natural state uninterruptedly, without any alteration or diminution in any of the qualities making up its character, that is, in its level, quantity or purity.

This right is necessarily limited by the equal right of every other owner to the same thing. Where the limiting line is to be drawn may be found in the answer to the question—Has the one owner used his rights or right in a reasonable manner, having regard to the interests of the other riparian owners? It may then be asked what is meant by “reasonable,” to which the only answer that can be given is, *that* is reasonable which appears reasonable to the tribunal who hear the facts of each case, in other words, to the jury; not perhaps a very satisfactory answer, but the only one which can be given. Perhaps the best guide to arriving at a conclusion is to state in detail what it has been decided an owner may or may not do, though it is obvious any conclusion we may draw from such premises can only be approximately correct.

First, with regard to the flow of the stream. A riparian owner may not alter the level of the stream either where it enters or leaves his property; he must not pen back the water as it enters his lands, so as to injure the lands above him, or to prevent the upper owner from making such use of the fall as he may have occasion to do; on the other hand, he must not pen back the water as it leaves his land so as to diminish the amount of the water, or to disturb the steady flow and regular current of the stream.

Then he may use the water in two ways, either by way of motive power, or in consumption for irrigation, for drinking purposes or manufacture. If he wish to use it

for motive power, he may direct the water, by a cut, to a mill or other machine, but then he must carry the water back into the stream before the stream leaves his land, and must so manage the diversion as not to interfere with the regular flow to the owners below.

Again, he may use it for the purposes of irrigation, but the right of irrigation must be used, subject to the rights of the other owners. Thus it had been laid down that the user for irrigation would not in every case be a lawful enjoyment of water, even if the water were again returned to the river after being directed on to land with no other diminution than that which was caused by absorption; that this must depend on the circumstances of each case, for, on the one hand, it could not be permitted that the owner of a tract of many thousands of acres of porous soil abutting on one part of the stream could be permitted to irrigate them continually by canals and drains, and so cause a serious diminution of the quantity of water, although there were no other loss to the natural stream than that arising from the necessary absorption and evaporation of the water employed for the purpose, but that on the other hand one's common-sense would be shocked by supposing that a riparian owner could not dip a watering pot into a stream in order to water his garden. It is thus, as the Court added, entirely a question of degree.

Again, he may use it for drinking purposes, for watering his cattle, or other purposes to which water is ordinarily applied; but it was held that the abstraction of water from a flowing stream to supply a gaol or lunatic asylum was a purpose more extensive than those to which a riparian owner has a right to apply the water.

Again, he may use the water for manufacturing purposes, but he must not alter the quantity or purity in any sensible degree. Thus, he must not return the water in a

heated state ; he must not turn sewage into the watercourse to such an extent as to be perceptible ; he must not render the stream unfit for any of the ordinary purposes of which we have already spoken.

Again, water, while percolating underground or flowing in no defined channel, whether under or above ground, is the property of the first person who can appropriate it. Therefore, a landowner may, by sinking wells on his ground, collect water for his own use to such extent as he may think fit, and his neighbour, whose well may have been drained by such sinking, has no redress ; but a riparian owner may not, by sinking a well close to the stream, draw off the water from it through the land to the prejudice of other owners.

As has been said, no riparian rights, properly so called, can be acquired over artificial streams. Such streams may be the subjects of easements, and we will now proceed to discuss the nature of such easements.

Every owner of land is entitled to drain his land, for the purpose of cultivating, in any way he pleases ; so long as the water on it remains mere surface water, or the land is swampy, and the water though percolating through it cannot be said to flow in a defined channel, he may deal with it as he pleases, and direct it into any channel he may think fit. He may, before the water has found its way into a defined watercourse, intercept and appropriate it as seems to him good. Therefore, where a man by draining his land intercepted water that used to run into a brook which turned the plaintiff's mill, the Court held that the plaintiff had no right as against the defendant to the natural flow of the water intercepted by the drain.

There, though the plaintiff was deprived of a water power he had hitherto enjoyed, it could not be said that the defendant had actively contributed towards giving him the use

of it. But many cases have arisen where a land owner or mine owner, having poured water from his land or mine over his neighbour's land, has either diverted or stopped the stream, much to the inconvenience of the lower proprietors, who have attempted to establish some right to the enjoyment of the water, but without success, and for this reason. A man has, because his lands are higher than his neighbours, either a natural easement or by reason of long user an acquired easement, entitling him to get rid of his water by pouring it over his neighbour's land; in either case such an easement is a right, created for the benefit of the dominant owner, and does not, therefore, operate to create a new right for the benefit of the servient owner.

Therefore, though the discharge of water be advantageous to the owner of the servient tenement, the owner of the latter cannot acquire a right to have it discharged on his land if the dominant owner chooses to send the water elsewhere or to apply it to another purpose. Thus, the flow of water from a drain made for the purpose of agricultural improvement for twenty years, does not give the neighbour a right to the continuance of the flow, so as to preclude the owner from altering the level of his drain for the improvement of his land.

Again, a mine owner who has brought water to the surface on the plaintiff's land for the draining a mine, may divert it when deeper draining is required, and no action will lie against him by any owner of a servient tenement—and further, as the owner who brings the stream to the surface does so merely to get rid of a nuisance, he cannot be considered as giving it to one more than another of the proprietors of the land through which the artificial stream flows: each may take and use what passes through his land, and the proprietor of the land below has no right to any part of that water until it has reached his own land;

he has no right to compel the owners above to permit the water to flow through their land for his benefit, and consequently he has no right of action if they refuse to do so. (*Arkwright v. Gill*, 5 M. & W.; *Wood v. Wand*, 3. Ex. 748; *Greatrex v. Hayward*, 8 Ex. 291; *Mason v. Shrewsbury*, R. L. R. 6 Q.B. 587).

But though a lower owner cannot compel an upper owner to let an artificial stream pass in undiminished quantity, he can prevent the upper owner from defiling the water and passing it on in a polluted state; a cause of action apparently arising from the injury sustained after lawful appropriation of the water. (*Wood v. Ward*, 3 Ex. 779; *Whaley v. Laing*, 26 L. J. Ex. 327.)

It only remains now to deal with the class of easements which can be acquired alike over natural and artificial streams. An easement has been defined to be a privilege, without profit, which the owner of one tenement has a right to enjoy in respect of that tenement in or over the tenement of another person, by reason whereof the latter is obliged to suffer or refrain from doing something on his own tenement for the advantage of the former. The easements with which we have now to do are those which exceed in their extent, or are at variance with, the natural rights in natural streams and the rights similar to them in artificial streams which have been already spoken of, such as rights to divert, pen back, or pollute waters. Such rights may be acquired in five ways. 1. Under a grant 2. By virtue of an Act of Parliament. 3. Under a devise. 4. By prescription. 5. Under a custom. In this place it is probably sufficient to confine the discussion to one way, that of prescription, and to the simplest form of prescription, that by enjoyment for twenty years uninterruptedly.

The measure of a prescriptive right is the accustomed user, and thus, where a part of the water of a stream has

been so long diverted to a mill that the mill-owner has acquired a prescriptive title to divert it, his right is limited to the diversion of that quantity of water which he has been accustomed to divert, and he cannot, by altering his machinery suddenly, acquire a more extensive right.

But a difficulty occurs where the user has been varying in extent. A right to pollute water may be acquired by prescription; but suppose the quantity of foul matter, cast into the stream, to begin in small quantities, and by increase in the number of houses, or increased manufacture, gradually to become greater, it is clear that the pollution may at the beginning of twenty years have been very trifling, compared with the pollution at the end of the period.

It appears that under such circumstances, where the pollution is increasing and gradually increasing, the persons who allow the polluted matter to flow into the stream, are not at liberty to claim any right or prescription (*Goldsmith v. the Tunbridge Wells Improvement Commissioners*, L.R. 1, Eq. 161, 1 Ch. Ap. 349); so that, if the pollution at its commencement was defined in amount and originated from some certain cause, the measure of the right will be the extent of the pollution; but that if there has been no defined commencement, no right can be gained. When the right to pollute has been obtained, it is a right, in ordinary cases, not merely to pollute the water in a particular manner, but to pollute it to the particular extent in that or any other manner (*Baxendale v. McMurray*, L.R., 2 Ch. Ap. 270). If, in the exercise of a right to pollute, the dominant owner exceeds the limits of his right, the servient owner may obstruct the user which is excessive, if it be possible to obstruct the excessive user without stopping that which is rightful; but if it be not possible, it would seem he obstructs the enjoyment of the right altogether (*Caukwell v. Russell*, 26 L.J., Ex. 34). The instances above given have been all

of rights of pollution, but the same reasoning applies to all the other rights whether diversion, penning back, or disturbance of water.

In conclusion, I may add that a salutary statute has been recently passed, in the Session of 1876, on the pollution of rivers. For years previously the riparian rights of owners of lands and manufacturing buildings have been abused, to the great detriment not only of other owners, but of the public at large. Though the common law of the land may be sufficient to meet such cases, its machinery was cumbrous and expensive; and the new Act, by defining more clearly the law as to sewage, manufacturing, and mining pollutions, and by giving jurisdiction to the County Courts to restrain those who offend against the law, holds out some hope of an effectual remedy against that wholesale destruction of pure streams which has long been threatened by the increase of towns and manufacturers on the banks of our different rivers.

I will not now refer to the duties of riparian owners. Rights imply duties, and, however ill defined these latter may be, they exist. The recent floods may, perhaps, bring the facts home to many riparian owners, and as, doubtless, they will be discussed in the course of this evening, I will leave what I have to say on the subject to my reply.

MR. T. CHATFIELD CLARKÉ (Member) said that all present would, he was sure, join with him in passing a vote of thanks to Mr. MARRIOTT for the Paper which he had so kindly prepared, and which, he trusted, would serve as an introduction to an even wider discussion than could arise in connection with the strictly legal aspects of the subject. There were questions which were pressing upon every man's attention at the present time, in connection with a great river not very far off, which seemed to suggest the desirability of an enquiry into the subject of tidal streams.

There had lately occurred, in his professional career, one of those mortifications arising out of the uncertainty of the law with regard to riparian ownerships. He happened to have been connected with a suit which had gone the way of many other suits, the first judgment being reversed on appeal, and confirmed on a second appeal, involving everyone concerned (though the question was a strictly legal one) in a large expenditure, rendered greater by the fact that, in acting upon the judgment of the second Court, considerable outlay was incurred for works, the removal of which was rendered necessary by the reversal of the judgment by the third Court.

Connected with this subject of Riparian Rights was that of the Conservators of the river Thames who could give a license to embank under the powers they possessed, and then withdraw and not be prepared to maintain the license which they had given—thus throwing upon the owners and dwellers on the river side expensive litigation, and the results to which he had referred.

He trusted that he would not be considered to be trespassing beyond the proper scope of the discussion, by referring to the arguments which he saw constantly advanced with reference to the liability of private owners of property, vestries, and other public bodies, on the south side of the Thames to be saddled with the whole expense of constructing an embankment on that side. He had seen nothing in the arguments put forward by the public press and by eminent engineers, to convince him that it was right to saddle a portion of the Metropolis—the inhabitants of that portion being ratepayers, contributing to the expense of the northern embankment which to a great extent had caused the mischief—with the whole cost of constructing an embankment on the other side. Such a contention appeared to him to be inequitable, and he should be glad

if some gentleman would take up the question in the course of the discussion.

Mr. E. RYDE (Member) begged to second the vote of thanks to Mr. MARRIOTT for undertaking the duty of calling attention to this matter, notwithstanding his many engagements. No occasion could be more opportune for a Paper of the kind, the present season being such as occurred only once within a natural lifetime, thrusting riparian matters upon the attention not only of the parties interested, but of the public generally. Mr. MARRIOTT's Paper would form a most useful introduction to the discussion of this subject, defining the state of the law respecting it; but there were a vast number of questions connected with riparian rights which were not touched upon in the Paper, and which might form the subject of future discussions. The present Paper, however, suggested sufficient matter for one evening's discussion, even without going into the points raised by Mr. CLARKE. A case came under the notice of himself and Mr. SQUAREY a few years ago, and which was as yet unsettled, which was well worthy of attention by Mr. MARRIOTT when the time came for his reply. In this case two rivers ran very nearly parallel to each other, but one on a higher level than the other, and the land between them belonged to two owners. The land of one owner was a little higher than that of the other; and the owner of the higher land irrigated his ground from the higher river, and, by way of arrangement, allowed the water, instead of passing back again into the stream from which it was derived, to flow over the land of the other owner, lying at a lower level. By and bye the neighbouring town established waterworks, and took their supply from these streams; and the owner of the lower land claimed compensation from the Company for the loss of the water to

the use of which he had been accustomed. The question, which as he had said, was still unsettled, went before a Jury, with other matters of compensation, but was withdrawn from consideration.

Mr. W. H. MICHAEL (Associate) feared that he could add little by way of comment upon the very admirable description of the law of riparian rights which had been brought before the Meeting by the author of the Paper. He was a little disappointed that Mr. MARRIOTT did not take up more of the question of tidal streams, which was a subject of great importance and one to which attention was likely to be called at the present time, and offering more scope for discussion than that to which he had confined himself.

As regarded the general question of riparian rights, it must be remembered that each case depended upon its individual peculiarities, which alone must regulate the application of the principle laid down; and, as in Mr. CLARKE'S case, every one concerned in matters of the kind must be prepared for the reversal of the judgment given in one Court by the judgment of another Court, and even then find, possibly, that another opinion might be arrived at by a third Court, though that third Court might be no better constituted than the lower one to deal with such matters. Observing that Mr. NORMAN BAZALGETTE, who had devoted a great deal of trouble and much of his time to the subject of embankments, was present, he (Mr. MICHAEL) would not trouble the Meeting with any remarks having reference to works of the kind; but he could not forbear expressing an opinion that the question as to who was to pay for the construction of an embankment necessary for protection against an overflow of water in a particular district, was a totally different matter from the necessity for a work of great

public improvement which was to benefit the whole of the metropolis.

The embankment on the northern side of the Thames was not for the purpose of keeping out the water, but for the relief of the whole of the traffic of the metropolis. It was to do that, in fact, which all were interested in, and which could only be done by means of that embankment; therefore it was right that it should be paid for by general taxation, inasmuch as it was a source of general benefit. Who could say that the manufacturer on the south side would not derive more advantage from the northern embankment than he (Mr. MICHAEL) who lived close to it, but as a private resident only. A man in Lambeth, sending half-a-dozen carts in the course of a week, might, in escaping the crush of traffic, save £5 a week by having the use of the embankment instead of being delayed in the crowded streets. That was but one illustration of the vast advantages afforded, without doubt, by a general improvement. No doubt, it was open to discussion whether or no the making of the northern road injured the southern shore, by diminishing the space in which the water could force its way; and it had always seemed to him that if (arguing the question *ad absurdum*) the stream were reduced to one foot in width instead of a thousand, there must be some damage accrue, though with a large basin above, the damage would be less. But the fallacy into which Mr. CLARKE had been betrayed was this: he contrasted the mere liability to an evil with an improvement of the highest general importance—a public embankment, namely, which was to carry out a public purpose, with works to avoid private injury from overflow. The two could not be compared. The necessity of providing some safeguard against the invasion of one's premises by water was a very different matter to a work for saving the general traffic of the metropolis, and no contrast

between the two facts was possible. It was a question of purely personal advantage, if one wanted to keep water out of one's cellar, to go to the expense of making a wall ; but, by the neglect of these obvious precautions, the people on the southern shore of the Thames had more than doubled the injurious effects which might be supposed to have resulted from the construction of the northern embankment.

He would ask Mr. CLARKE to consider what public improvement could be carried out without inflicting a hardship upon some one.

Mr. CLARKE said that he would only ask Mr. MICHAEL whether it was not equally present to his mind that no injury could be created without due and adequate compensation.

Mr. MICHAEL said he only wished that were so, but as a fact it was altogether diverse to the law as he understood it. There were thousands of injuries inflicted without compensation. Suppose he had a field which he had acquired after years of trouble, and was rejoicing in its possession, and that, for a public purpose, it was necessary to take it, in order to accommodate three millions of people in the metropolis. In that case there would be a great wrong done to him which money could hardly compensate him for, yet, on the ground that it was for a public purpose, his private rights must give way. Therefore, he contended that, although the public improvement had perhaps done some damage, it did not in any way affect the private question of the necessity of the private owner making an embankment for the purpose of keeping out the flood on his low lying premises ; in fact, he might go further, and say this, that the man who had erected that house had done a public wrong, and it was his duty, looking at the matter *publici juris*, to keep the water out. If he had chosen to utilize a portion of his

property in such a way, he had, by so doing, inflicted damage not only upon himself but also upon others.

If asked whether the embankment on the south side ought to be contributed to by people on the north side, he would unhesitatingly answer, Yes, as the south had contributed to the embankment on the north side : that was, always assuming it was for the public use. It was the duty of the individual to protect his own property, and to pay for that protection ; but if a public advantage were to be gained, then it would be the duty of the public to contribute.

MR. C. NORMAN BAZALGETTE (Associate) said that he proposed, in the remarks which he was about to offer, to deviate from the paper to this extent that, with the sanction of the meeting, he would discuss the question of the liability of those who had permitted the floods, and the responsibility of those whose duty it was to keep out the floods, and particularly in reference to the Lambeth overflow ; but he did not intend to go into the engineering question whether the construction of an embankment on the north of the Thames had sent more water to the other side of the river. That question would have to be fought out at another time and in another place, and he was content to abide the result of that discussion whenever it took place. It seemed, however, to him that for present purposes he should be meeting the paper fairly enough if he simply entered into the question of the incidence of the responsibility of preventing floods within the metropolitan area. The point which had been raised with regard to the embankment, as he had already observed, was outside the limits of the discussion proper, and would only serve to embarrass the legal issue. As it was, there was no engineering argument before the meeting, and therefore nothing to combat. It was true that a mere assertion had been made

that the embankment on the northern had sent more water to the southern shore, but in the absence of argument to fortify that statement, a simple counter-assertion would be sufficient for present purposes.

With regard to the concluding remarks of the Paper, some reference had been made to the Rivers Pollution Act which was passed last Session. He agreed with the author of the Paper that some of its provisions were beneficial and calculated to do good; but, nevertheless, there were one or two provisions which, to his mind, tended to place a stumbling-block in the way of the efficient operation of the statute. To indicate one such defect. That statute provided that no person should send sewage into a stream, and then further enacted that no person should be convicted if it could be shown that he had taken the best practicable means for cleansing the sewage before it passed into the stream. Now, it seemed to him (Mr. BAZALGETTE) that those latter words impaired the beneficial effect of this provision, for they let in the whole of the vexed question of what constituted the best practicable means. One expert, for instance, would say chemistry afforded the best results, while another would recommend natural or artificial filtration through soil as effecting more complete purification. Thus it would have been far better if the statute had simply provided that, instead of its being necessary to prove that the best practicable means had been used, it should be enough to show that the sewage had been sufficiently cleansed, because in that case the question of sufficient purification would depend upon chemical analysis, which would probably not be much at fault.

The author of the Paper had confined his remarks to the case of rivers beyond the range of the tide. Now he proposed to take the subject up just where Mr. MARRIOTT had dropped it, and to deal with riparian ownerships fring-

ing the borders of tidal streams, and at the same time to discuss the position of seaboard ownerships, and their relations with each other.

First of all with regard to the common law of the land relating to seaboard ownerships, he thought Mr. MICHAEL would bear him out in his statement of the law with regard to such proprietors, when he said that the principle was fairly laid down in the case of *Rex v. the Commissioners of Sewers for Essex*, 1 B. & C. In that case, Chief Justice Abbott decided that, in the absence of proof of special usage binding the individual frontager, all the owners upon a flat like the Lincolnshire flats, were bound, in common, to contribute to the expense of keeping up the sea bank which gave them common protection. But, on the other hand, a special usage binding the frontager on the sea might be proved, in which case he would have to perform the duty of keeping up the sea bank at his own cost. That law was approved in *Morland v. Cook* L. R. 6 Eq. Cas. Then there was the remarkable case of *Hudson v. Tabor*, which was decided in the Queen's Bench, and was now being carried up to the House of Lords, and the general effect of which was to confirm the principles of the joint liability of the owners of the flat in the absence of special usage, though special usage and prescription could saddle any frontager with the special responsibility.

His friend, Mr. MICHAEL, had called his attention to the fact that the principle of joint contribution proceeded upon the view that, inasmuch as the sea was the common enemy of all, all should combine for the purpose of resisting its incursions.

Passing on from sea-board owners, he would next consider the law as affecting water-side premises situated on the banks of tidal rivers or estuaries, and he thought it would be found that the two cases were nearly analogous.

With regard to the statutes which had been passed from time to time for the prevention of floods, he should like, in order to lead his argument with reference to the liability for the Lambeth overflow to a logical conclusion, to refer to some of the principal.

The first statute which legislated with this intention was *Magna Charta*. It only consisted of thirty-seven chapters, and as one chapter consisting of only about two lines was devoted to that object, he would quote it in its entirety. He might premise that the words "put down" meant removed or demolished. It ran thus:—"All weirs shall be henceforth utterly put down by Thames and Medway, and throughout all England," the object then being, not as at present, to keep up the locks and weirs to improve the navigation, but to remove obstacles in order that the upland water might flow down as rapidly as possible at low tide, so that the accumulated volume might not be ponded back more than was necessary when the tide was at its full height.

The next statute was the 25 Edw. III. c. 4, which was to the same effect. The next was the 1 Hen. IV. c. 12. This latter enabled Justices of the Peace to make surveys, and also to make orders calling upon the freeholder to break down any such impediment created by them. There was also a provision in the same Act, which made it incumbent upon the owners of weirs and other obstacles to remove them at their own cost, failing which they were subject to a fine of 100 marks to the Crown. The next was the 23 Hen. VIII. c. 5, of which the preamble seems to have been conceived in a spirit of sarcasm, for it began by calling the King "a virtuous and most gracious prince." It then proceeded in quaint language to complain of "the outrageous flowings, surgings, and course of the sea, the occasion of land water and other outrageous springs that

flooded low lying grounds," and it wound up by creating Commissioners of Sewers throughout the kingdom. These Commissioners had charge of certain levels, and their duty was to survey and find out where fences against the tides, whether in tidal rivers or in the sea proper were insufficient, and it gave them power to compel owners to make them good. He believed, as a matter of history, that the Commissioners exceeded those powers, for whereas the statute enabled them to cause them to be executed, they took upon themselves the duty of constructing the necessary works.

He would now supply the references to the principal Acts, for the information of those who were desirous of looking into the subject. They were 3 & 4 Edw. VI., c. 8, 13 Eliz., c. 9, 3 & 4 Wm. IV., c. 22, 4 & 5 Vict., c. 45, 12 & 13 Vict., c. 50, and 24 & 25 Vict., c. 133. This last was the Lands Drainage Act, which made the tenure of office of the Commissioners perpetual, the term having previously been limited to three years. The last of these Commissions was issued in 1860.

He had now stated generally what the law of the land was, both as affecting river frontagers and seaboard owners. Next, as regarded the metropolis, the low-lying lands within the metropolitan area were, like other river-side flats, under the charge of Commissioners, and these Commissioners had power to enquire where defences were weak, and to make orders concerning them which bound those deriving benefit from their protection. The authority of these Commissioners was afterwards supplanted, in the metropolis, by the machinery provided by the Metropolis Local Management Act, though, outside the Metropolitan area, the authority in some cases still survived. It seemed to be imagined that because the Metropolitan Board of Works had jurisdiction over the metropolis with regard to some matters, they were consequently

omnipotent. Their jurisdiction had been exaggerated. He ventured to say that, with regard to this question of floods, whether within or without the metropolis, no public body, as he would shortly show, could have a much more limited jurisdiction than the Metropolitan Board of Works. For instance, outside the metropolis, the Board, by virtue of the land which they had acquired for the purpose of their outfall at Barking Creek, fell under the jurisdiction of the old Commission, which presided over that level, and sometimes received the most peremptory notices to raise their sea-walls. He had brought with him a specimen of these notices. The heading was "East Ham Level." It recited the district to which the level extended. Then it enumerated the names of those members at present composing the Commission, and then made order to this effect:—"That the Metropolitan Board of Works raise their Thames river wall, and Barking Creek river wall, as high as the altered standard level, viz., five feet above Trinity high water mark, or ten inches above November level of last year." It then went on to provide that the necessary works should be done within a month after notice given, and that, in default, the Marsh Bailiff would execute such works, and that their cost would be assessed and charged upon the Board.

He had with him another notice which was much to the same effect, and which he need not read.

A few words more, and he had done. He was afraid he had exceeded the compass allowed to a speaker, but, in conclusion, he wished to say a word as to the question of liability, particularly with regard to the Lambeth overflow. He need hardly tell them that, as regarded the metropolis, the Commissioners had been superseded by the jurisdiction of other bodies. First of all, their jurisdiction had been superseded by the Commissioners of Sewers. After that, the Metropolitan Local Management Act was passed, which was the Act now

in operation ; and, as regarded the question at the present time in the metropolis, it had introduced an entirely new state of things. He need hardly remind the meeting what the effect of that Act was. At the same time that it constituted a central body, it constituted vestries or local bodies all over the metropolis, those local bodies sending up representatives to the central body, and so forming the Metropolitan Board of Works. The Metropolis Local Management Act, 18 & 19 Vict., c. 120, gave concurrent jurisdiction to the Metropolitan Board and the Vestries in some respects, and an independent jurisdiction in others ; and where they found independent jurisdiction they might take it that the Metropolitan Board would not meddle with the Vestries, nor the Vestries with the independent jurisdiction of the Metropolitan Board. Then whose duty was it to prevent floods, or the overflow of the Thames in the metropolitan district ?

As the question was at present of public importance, he hoped he should be pardoned for referring to the particular section which regulated this. A section of an Act of Parliament was a dry thing enough in itself, and scarcely a matter of popular interest ; but still this section was so clear that it could not be put more tersely or in a more explanatory way if he adopted words of his own. Sec. 69 of 18 and 19 Vict., c. 120, was to this effect :—"The vestry of every parish mentioned in Schedule A to this Act, and the Board of Works for every district mentioned in Schedule B to this Act, shall cause all banks, wharves, docks, or defences abutting on or adjoining any river, stream, canal, pond, or watercourse in such parish or district to be raised, strengthened, or altered or repaired, where it may be necessary so to do, for effectually draining, or protecting from floods or inundation, such parish or district." That seemed plain

so far, and it was clearly the duty of the vestry to give effect to the provision. Section 70 apportioned the expense, and showed how it was to be provided for, enabling the vestry to charge the expense partly on the riparian owner and partly on the district—that was to say, it might be divided between the individual and the rates.

It might be asked then why, if the vestry had power, did they not step in to prevent the floods? The fact was that there appeared to be some difficulty in enforcing the provision in the case of a refractory owner. The Act of Parliament seemed to be defective. If any one would take the trouble to read WOOLRYCH's footnote to section 70 of the same Act of Parliament, he would find these words: "There is some difficulty attending the mode of proving and enforcing liabilities of this nature under the present Act," the author then going on to explain the nature of the difficulty. So that, in fact, there was an obstacle in the way of enforcing the statute.

In conclusion, he begged to thank the Members for the time and the attention they had given him, and at the same time to apologize to the author of the Paper for having wandered so far from what might be considered as the strict subject-matter of discussion, but, as Mr. MICHAEL had said, the Paper had treated of settled law, which admitted of comment only and not of controversy.

Mr. E. J. CASTLE (Associate) would only say a few words upon what had fallen from Mr. BAZALGETTE. The question was a very important and interesting one, and had engaged his attention for some time past. Mr. BAZALGETTE had declined to go into the engineering merits of the question in that room, but it was not easy to avoid reference to the scientific bearings of the subject if it were proposed to

discuss it at all. The question which could be discussed with most advantage on the present occasion was not one of technical law, but of the practical measures necessary to be taken to prevent these overflows for the future. The Metropolitan Board of Works executed the embankment by Parliamentary powers, and every lawyer knew there was no remedy at law against the Board in respect of injuries resulting from their works, except where special provision had been made by statute. The question, therefore, was not what the law was or had been, but on whom the legislature should in future impose the duty of providing against a recurrence of these disasters. His friend, Mr. BAZALGETTE, in order to show that it was not the duty of the Metropolitan Board to do this work, had produced a notice served upon them, which, however, it should be observed, was not a notice served upon them, *qua* Metropolitan Board of Works, but as owners of land and property at Barking Creek; and as owners of property in an outlying district they of course incurred the same responsibilities in all respects as other private owners. No one seemed to know, as matters now stood, whether they were to look to the local authorities for a remedy, or whether, the magnitude of the question being considered, the Metropolitan Board of Works was not the fitter body. Mr. MARRIOTT in his Paper had laid down the law "*aqua currit et debet currere*"; and no person had a right to build so as to prevent it from doing so by contracting the water-way, or by penning the water back. The question really was whether the Metropolitan Board of Works had not so contracted the water-way of the Thames.

He believed that, in the case of a tidal river like the Thames, the height to which the waters at times attained, was not a question of statical level, but of acquired momentum. He considered this to be the case, because whilst the level of high water at London bridge was about the same

as that at Teddington, at low water it was about 16 feet below, and, therefore, the tide had to flow up against that head of water.

If this theory were correct, the force of the tide would be due to momentum already acquired, which would be represented by so much water travelling at such a rate. If any restriction were created, it would necessarily follow, either that the velocity would be so increased, that notwithstanding the diminished volume, the same amount of water would pass, or some portion of the existing momentum would be converted into an increase in the height of the tide. Looking to the fact that it would require time to generate such an increase of velocity and that more work must be stored up to drive the tide at this increased velocity against the weight of the upland water, it seemed to him to follow, mathematically, that the diminution of the water-way would have a threefold result :—

- I. To decrease the quantity of water.
- II. To increase the velocity, but not in the same proportion. The remainder of the momentum producing not velocity but
- III. Increased height.

Whether the height or frequency of these floods was greater now than formerly, was a point susceptible of proof. Did the same amount of water get to Teddington as before the construction of the embankment? If not, it was kept back and was travelling at a higher level, in consequence of the narrowing of the waterway by the embankment. If it could be proved that the floods had resulted from the construction of what was acknowledged to be a work of great public utility, he thought that the minor questions of legal liability should be disregarded, and the matter treated in a broad and comprehensive manner by placing it in the

hands of a body competent to deal with it, like the Metropolitan Board of Works, or some other public body, such as the Commissioners of Sewers.

Mr. W. EVE (Member) said that he should be glad if Mr. MARRIOTT, in his reply, would give some information as to the right of mine owners in pumping out water, to allow it to take any channel it liked, when once out of their domain, and whether if, in so travelling, it did any damage, the owner of the land where such damage was done, could make or sustain any claim against the mine owner.

He thought Mr. BAZALGETTE's illustration of the powerlessness of the Metropolitan Board of Works with regard to the overflow of the Thames, was even more inappropriate than Mr. CASTLE had made out, for the property he spoke of, which the Board had been called on to embank, was out of the metropolitan district, and could therefore have nothing whatever to do with question.

Mr. DOUGLAS WALKER (Visitor) said that the question now raised did not come within the scope of Mr. MARRIOTT's Paper, which was limited, by the title prescribed to it, of "Riparian Rights." For the floods in the Thames, above locks, appeared to be caused by the locks and other obstacles in the bed of the stream, penning back the water; and, as Mr. MARRIOTT had said, no riparian owner had, from his position merely, a right to pen back the stream to the injury of his neighbour; but these locks were, he believed, vested, not in the riparian owner, but, by statute, in the Thames Conservancy, who would, on this assumption, be liable for damage done by the negligent exercise of their statutory power. This was not, therefore, strictly speaking, a question of riparian rights at all.

Assuming, with Mr. CASTLE, that the floods below locks were caused by the sea, the duties of the riparian owners appeared to be the same as the duties of those living on the sea-shore. He did not agree with Mr. BAZALGETTE's statement of the law that it was the duty of those living on the sea-shore to keep the sea out, and, had he come prepared to speak, he would have called attention to cases which would refute that theory. The Lord Chief Justice, in *Hudson v. Tabor* had held that a man was not bound to hold or keep the sea out against everybody behind him.

Mr. BAZALGETTE was sorry to interrupt his friend, but he wished to explain that what he had said was that a frontager to the sea was only bound by usage, and unless special usage could be proved against him, then the law was that all the owners of a flat were jointly responsible and jointly bound to contribute.

Mr. DOUGLAS WALKER, resuming, said that even then he was sorry to differ from his friend. He supposed there was an instinct in lawyers to quarrel, but it did appear to him that Mr. BAZALGETTE's argument was against him. It would be enough for him to say that, supposing it had been the duty of the people on the shore, apart from statute and prescription, to keep the sea out of the inland, then it was clear there would have been no necessity for any statutory enactment, because the frontager would have been bound to keep out the sea, and compellable to do so, or in default, liable to an action, if not to an indictment; whereas, in the reign of Hen. VIII., as his friend said, there were constituted a body of Commissioners, who were empowered to levy rates upon everybody in the inland, so as to apportion the contribution, and to make it equal for all parties. From this it would appear that the inland folk could

not, before the statute, compel those who were dwelling near the sea to build the sea walls. Whether there was any remedy against the body alleged to have caused the present floods on the south shore, was another question, and one that could only be determined, at much expenditure, by wiser persons than himself.

On the motion of Mr. R. B. GRANTHAM, seconded by Mr. R. C. DRIVER, the discussion was then adjourned.

AT
THE ORDINARY GENERAL MEETING,

Held on Monday, January 29th, 1877.

THE PRESIDENT IN THE CHAIR.

The adjourned discussion on the Paper by Mr. W. T. MARRIOTT entitled "Riparian Rights," was resumed by—

Mr. R. B. GRANTHAM (Associate), who said that he would not have ventured to re-open the discussion on this (strictly speaking) legal Paper, had not Mr. MICHAEL and Mr. C. NORMAN BAZALGETTE at the last meeting widened the subject under discussion, by allusions to riparian rights and liabilities on tidal rivers, questions with which he had had a great deal to do in connection with Commissions of Sewers. These Commissions, appointed under the 23rd of Henry VIII. and under the Act of 1861, covered a great area, the Land Drainage Act alone applying to over 80,000 acres, the others having no defined boundaries. The old drainage law gave only a sort of rambling jurisdiction, regulated by the height of the tide against high lands, which determined the area liable to be rated in respect of protective works. The Land Drainage Act altered this state of things, extending the power up the country, so that many lands could be included in the drainage district, whether affected by the tides or not. These jurisdictions were fixed by a defined boundary, so that the incidence of the rating was in proportion to the benefit conferred. The sea banks, particularly

in the cases upon which he had reported in Somersetshire, and many others in various parts of the country, were excessively difficult to manage. The Commissioners of Sewers had certain powers to secure their maintenance, but they were afraid to exercise them. The Commissioners would call upon the persons who had frontages on the sea to repair their portion of the banks, but the work was done with great difficulty, and both parties were very much afraid of the law. Still, those who had frontages did it partly for their own protection and partly under compulsion. In those cases in which representations were made that the frontages or banks were in an unusually bad and dangerous condition, the Commissioners had power to repair them themselves, but they were limited as to the expenditure, so that if the work were of any great extent, they were practically precluded from undertaking it. The frontages were of course of very varying lengths, in some cases being little more than a yard, in others several thousand feet.

Many of the large proprietors felt it to be to their interest to repair the banks; the difficulty generally occurred with the small frontagers of, say, 10 feet or so, whose neglect to repair their portion of the banks exposed large areas of land behind them to the risk of inundation. This was particularly the case under the old laws. He was not aware whether there had been any case under the Land Drainage Act connected with frontages upon the sea. Almost all the cases under that Act had occurred in connection with inland rivers.

Referring to the difference of opinion as to the cause of the floods in the Thames, he thought that all engineers who had studied the question at all, were unanimous in their opinion that the construction of the Thames Embankment had in no way contributed towards the recent inundations. The tides flowed up to a certain level and then receded,—there had been no material difference so far as they were concerned; but a

far greater quantity of upland water came down than in the days before subsoil drainage, and piled the water up in the neighbourhood of London, thus flooding wharves and house property where proper precautions had not been taken by raising or repairing the walls. He had said that there had been no material difference in the height of the tides, but that there had been a slight increase in their height—whether owing to excessive equinoctial gales, or to some other cause, he did not know—was no doubt the case. He had been engaged in the repair of some very old embankments in Sheppey, which, notwithstanding the fact that they had been raised, had proved insufficient to keep out the floods; and this had been the case, he believed, with many other embankments throughout the country. He had a theory of his own that the bottom of the Thames had risen a little, thus affording a shallower channel for the water, but he had been assured by the Engineer of the Thames Conservancy that no such thing had taken place, but that, as a fact, the tide really flowed out more quickly than formerly.

The piling of the water might, perhaps, be accounted for by the narrowness of the river caused by Southwark Bridge piers. There were 670 ft. of water way there and 1,200 ft. at Waterloo Bridge, and formerly the tide was piled at Southwark Bridge and rose on both sides of it. Of late years, that had not been the case, owing to some reason which he could not explain.

Most surveyors who had land to manage in the neighbourhood of London would be interested in the Thames River (Prevention of Floods) Bill, which was being introduced by the Metropolitan Board of Works. Under its provisions, he believed that every riparian owner would be required to raise his banks, or protect the land inside. If he did not do so, the District Board would be called upon to do it, and, in the event of their neglect, the Metropolitan Board

of Works. The neighbourhoods or the land owners would be taxed by these bodies to repair. But there was a power under the Act to divide the expense over a larger district than that immediately affected by the floods. The proposed Act gave power to raise a bank as far as the boundary of Hammersmith on the one side, and Putney on the other—the limits of the jurisdiction of the Metropolitan Board of Works.

The pollution of streams might, he thought be more effectually prevented under the new Pollution Act than had hitherto been the case. There was one defect, however, in the Act which Mr. NORMAN BAZALGETTE had hit. It was this—that the pollution could only be stopped where it was proved that the person who had committed the nuisance had done all he could to prevent it.

One point he would like to refer to, although it was one which might be familiar to those who had the management of land, was this—that, wherever land is enclosed from the sea, the riparian rights went, as he understood it, from the shore to where the bank was built to shut the sea out.

Mr. J. WILLIS BUND (Visitor) wished rather to elicit information from the members on what he was about to say, than to contribute anything himself to the discussion. He lived upon the banks of a river where the riparian rights were rather peculiar, and had not, he thought, been much touched upon on the last occasion. This river (the Severn) was one of the most important rivers in the kingdom, and he had had a good deal to do with its various rights, or, he might say, *wrongs*. To take his own case first. He would not say that others had no riparian rights just because he happened himself to be an ill-used individual, but he should like to have the opinion of the Society on the

state of things which he had experienced, not only for the sake of himself but of other people also. He was, unfortunately, the owner of three large mills situated on the largest tributary of the Severn, nearest the tide-way. About the year 1842 the question of the navigation of the Severn first came under consideration, and various Acts of Parliament were passed for improving it, and the result of these Acts of Parliament was that various large weirs were erected between his property and the tide-way. These weirs had raised the level of the water about 18 inches or 2 feet between his property and the main stream; and he was told by the principals of public bodies who had erected them that, as the works were carried out under Acts of Parliament, he was not in a position to recover anything from the Navigation Company. The raising of the level of the water prevented him from working his mills for two or three days longer after the floods than would otherwise have been the case, owing to the weight and height of the back water. Another difficulty to be contended with was this—that all his neighbours above him had drained their land to a large extent, and he had been affected by their drainage, and the amount of water was further increased by draining done upon the adjacent lands also. The streams coming down from the mountains of Wales discharged their water very rapidly, and the floods ran off very quickly until they got to the point where the first of these weirs had been erected by the Severn Commissioners, and which stopped the water from running off; below the weirs came the tide, which also prevented the water from getting away, and the consequence was that a large portion of the district was flooded to a much greater extent than formerly. He and others had considered their remedies for a long time and had come to the conclusion that none existed. All who were acquainted with the Severn were aware that it had a very narrow outlet for

its water, consequently, every high tide running up the river pounded the water back and flooded a good deal of the surrounding country, and the increased evil was mainly due to the erection of these weirs by the Severn Commissioners. This was the case also with the Avon, which, having very low banks, a small amount of blocking up at the outlets, resulted in the flooding of a very large district. Of course, those interested were told when these changes took place, that they would very much improve their drainage; that the water would go off more quickly through the locks, and all that kind of thing: but the result had been that a great portion of the country traversed by the river had been rendered far more liable to floods than formerly. The apparent absence of any remedy increased the hardship of the case, and he could not help thinking that it was owing to the apathy of the proprietors in not considering their rights worth enforcing, that matters had been allowed to go on till they reached their present pitch. Now, the low country between Worcester and Gloucester was very flat, and a very large amount of land was rendered, he would not say useless, but much less valuable than it would otherwise be. He must say that he did not see any remedy for the injury arising from these works, inasmuch as they had been authorized by the Legislature, but he would be glad of any suggestions on the point from any of the Members of the Institution.

The last speaker had alluded to the Land Drainage Act. He might perhaps be allowed to mention what fell under his (Mr. BUND'S) notice as regarded that Act. Some of the Members had very likely heard of the matter before, which came before the Court of Quarter Sessions of Worcestershire a short time ago. The landowners had executed certain improvements, and another gentleman (a private owner) had also made certain drainage improvements on his land, and a

rate was proposed by the Drainage Board, who assessed the rate on the value of the improvements effected, and a contest arose between them whether the improvements were caused by the Board's or the individuals' works. The Board contended that all the improvements had been due to them, because their providing the outfalls had enabled the proprietors to drain their land. The proprietors, on the other hand, contended that they had expended their money, and drained their lands, and had thus caused the improvements, and now the Drainage Board proposed to rate them on their own improvements. The appeal came before the Court of Quarter Sessions at Worcester, and was referred to a celebrated engineer and surveyor of Birmingham, and ultimately to Mr. WOOLLEY, one of the Vice-Presidents of this Institution. The case involved riparian considerations of very great interest—whether a body supplying the means of draining land, and thereby giving greater facilities than before for getting rid of the water, was entitled, in consequence, to impose a rate upon the land in respect of improvements made by the owners, but which could not have been effected without the works of the Board.

The mines in the upper districts of the Severn had given much trouble with regard to the water. He had for some years been one of the officials of the Severn Fishery Board, which had had a great deal of difficulty with large mining companies upon the question of their right to turn their refuse into the rivers. One company argued that they had a right to turn it into a small brook which ran into the Severn, and accordingly poured into the river a large amount of poison in suspension—generally arsenic—which killed a great quantity of fish.

It was said by Mr. MARRIOTT that the Act of last Session was a salutary one. He regretted to say that he differed from him entirely, for he thought it was not worth

the paper it was written upon. His Board had been called upon to consider the matter very carefully, to see what steps should be taken towards carrying out its provisions. He went, shortly after the Act was passed, to one of the largest proprietors in the neighbourhood, and said, "Now that we are armed with this Act, let us see what we can do," and suggested certain "available" means for preventing the water from being discharged into the river. He said, "I shall not adopt it." He (Mr. BUND) said, "We can compel you." He replied, "No—the conjunction *and* is used—'available *and* practicable means.' " We have taken advice on the matter, and are prepared to resist, because the words are both *available and practicable*. You must show us that the means are not only available but practicable also." He was quite prepared to admit that the carrying out the intentions of the Act would cost the person creating the nuisance a considerable sum of money ; but still he thought the Board were justified in insisting upon the person spending money rather than suffer him to pollute a river like the Severn, which furnished the water supply to so many large towns.

He looked upon the Act as an admission that rivers were polluted, and that there ought to be legislation for the purpose of preventing it. He had come rather to learn than to give information on these subjects ; but he would be glad if some gentleman could tell him what were the rights of riparian proprietors in such cases as he had mentioned on the Severn—cases which affected many thousand acres of valuable land most seriously, by these increased floods and by the parliamentary powers which had been conferred upon particular bodies such as the Navigation Commissioners in this case.

Colonel G. A. LEACH (Honorary Member) said he would

venture to offer a few observations which occurred to him in reading over the Paper of Mr. MARRIOTT, and the discussion which took place on the last occasion. The discussion had touched rather upon the wrongs than the rights of the riparian owners, especially those on the banks of the great metropolitan river, and the last speaker had followed in the same track. As regarded the Thames, he quite agreed with Mr. GRANTHAM that the embankment was not in any way the cause of the floodings which had taken place at Lambeth and elsewhere. But he thought the Institution must not confine itself merely to the case of the Thames; for the question was a large one, and extended over the entire country. Reference had been made to the drainage of the Ouse, and there were very extensive floods there at the present moment, also in the lowlands of the Trent; and he had had a conversation that day with a gentleman from Somersetshire, who had informed him that at that moment there were upwards of 100,000 acres under water in the neighbourhood of the Parret and other rivers in Somersetshire. These floods, he believed arose from four causes. In many cases from obstruction of outlet; in other cases from neglect of the channel of the rivers where navigation had fallen into disuse; in other cases from mills and weir obstructions; and, lastly, to a very great extent, from the channels of the rivers not being sufficiently large to enable them to carry off the flood water now more rapidly brought down to them in consequence of the thorough drainage of a large extent of cultivated land. It would be interesting to hear the opinions of Members as to how far the increased subsoil drainage of the country had contributed to the magnitude of the present floods.

Now, all these causes could, no doubt, be remedied, and the expense of their removal would depend very much on

the extent of the works ; but it was worth while considering how far it was desirable in certain cases to remove flood water. In a general way, it was, no doubt, desirable to do so, but, as he understood it, in many of the flooded districts in which there was rich pasture, occasional floods were not a great injury to the land, provided those floods could be controlled, and did not lie too long upon it.

Now, there was another point of considerable importance. The expense of the works necessary to improve the drainage of any part of a river would depend to a considerable extent on the distance of that part from its source. The further from the source, the greater would be the quantity of water to be dealt with, and the expense would increase in proportion. After all, the great question was, who was to pay for the expense of the works necessary to remove the causes of these floods? Under almost all of the existing Acts—not only the old Acts, but the more recent ones also—only those were called upon to pay who were directly benefited by the improvement, and, so far as the existing Acts were concerned, he believed he was right in saying that, being generally for the improvement of agricultural lands, the agricultural lands only could be taxed. But in many cases (particularly in the case of Huntingdon and St. Ives on the Ouse) there was a considerable extent of property in the towns which were subject to these floods, and which would be materially benefited by any improvement in the channel of the rivers. Now, it was a question whether town property, as well as agricultural land, should not bear in these cases some share of the expense of any improvement to prevent the floods by which they were injured. That seemed a point well worthy of consideration, and which he should be glad to hear any observations upon.

There was also a further question—should the drainage of a river be paid for by the whole district for the whole

extent of the river ; or should one portion of a river valley bear a larger charge than another when the works were more expensive at one part than the other ? It frequently happened that rivers were divided into several separate levels, and one portion might be improved without the other ; and it was a question whether the arterial drainage of a river should be treated as a whole, or divided into separate sections, and this, he thought, was a question well deserving attention.

The same principle applied to the Thames. It had been asked who was to pay for banking out the waters of the Thames, and preventing the floods in Lambeth? One could see no great reason why the proprietors themselves should not bear the expense. It was said that the owners of the property should not alone be called upon to bear the expense, because they had borne the expense of the embankment on the north side of the river. Now, it must be remembered that the embankment on the north side of the Thames was not made for preventing floods only, but to improve, as Mr. MICHAEL had remarked, the traffic and beauty of London. Now, if the same be necessary on the south side of the river, by all means let it be paid for by all London ; but if it be only to prevent floods, he saw no reason why the property benefited should not bear the expense of protecting itself from floods. It was one of the duties of the riparian owners to protect their own property from floods. Those were points which seemed to him to be deserving of the consideration of the Institution.

Mr. A. GILES (Visitor) thought that everybody would agree that the late destructive floods were due not merely to an excessive rainfall, but to the fact also that a great breadth of land had been under-drained of late years, and that, in consequence, waters were brought down to the outlets more rapidly than was formerly the case. Nothing could be

worse than the system adopted on the banks of some tidal estuaries, particularly the Parret, in Somersetshire, where every riparian owner, no matter how small his frontage, was bound to keep up his portion of the sea bank. Where a man was a large owner, and largely interested, he did his work perfectly ; but the next owner (of perhaps a few acres, and only 10 or 15 yards of frontage) was possibly a poor person, and neglected his duties. The consequence was that, when a heavy flood or storm came, the bank was washed away, and the whole neighbourhood was devastated ; and this man, whose neglect had caused the mischief, being a man of straw, could not be held answerable for it. Now, he submitted that the system could only be satisfactory if carried out by commissioners, or some combination of interests taking charge of the district. There were, at the present moment, nearly 100,000 acres submerged in Somersetshire, and this was owing not entirely to the floods, but, in a great measure, to the failure of river banks which had been neglected.

No doubt the rainfall of last December had been very great, but it was not the first time that heavy floods had occurred, as had been pointed out in the public journals. The question was, what was the remedy? Simply to remove the obstruction, whatever it might be. In many districts the mills and mill-dams restricted the flow of the water, and rendered proper drainage impossible, and an Act of Parliament, to authorize the removal of these obstructions, was necessary before any great improvements in the river could be effected.

As to the causes of the floods in the Thames, he was old enough to remember that, when old London Bridge was standing, the water was pounded on one side or other of the bridge, as the tide ebbed or flowed, in such a manner as to render it almost impossible for it to find its level. That

had been removed, and Southwark Bridge was now the narrowest part of the river; but, so far as he knew, it offered no obstruction to the flow of the water up or down. He had yet to learn that the new embankment by Hungerford Bridge could cause water to run up hill, and thus flood the Lambeth side. Unless materially obstructed, water would find its own level; and it was simply a contest between the tide running up and the upland water running down as to where the level would occur. If very heavy, the flood would overpower the tide and run out; but the tide at high water would naturally pound back the floods without any reference to the embankment at Hungerford Bridge. The fact was (however slow people might be to recognise it), that the amount of water to be dealt with in floods was very much increased of late years by subsoil drainage, and there existed no remedy for the present state of things but generally to widen and deepen the rivers and their outfalls.

Mr. C. G. GREY (Member) hoped that he might be allowed to widen the discussion a little, or, rather, vary it within the limits of the Paper. Mr. MARRIOTT had explained very clearly what the law was, but also that circumstances varied so much that almost every case depended on its own merits, and on the jury before whom it might be tried. Most of the Members knew by experience that, in consequence of the extensive drainage of land, water flowed much more rapidly into rivers than formerly, and so floods were frequent. He could cite instances where, formerly, he had noticed streams rise gradually until they reached a certain height, and for a space of time continued rising, and then subsided. Of late years he had noticed those streams rise high and suddenly subside, and then, in a few hours, rise and fall again. This was caused by the almost immediate flow of water from one

district (perhaps from tributaries nearest the spot where he happened to be), allowing the water to run off before the water from another tributary appeared. This was the case in what were known in Scotland as sheep-draining farms, where the drains were made to run almost directly up and down the incline—not across as formerly. The consequence was that, after a heavy rainfall, the water ran almost immediately into the stream in which it would ultimately arrive, a great deal in former times having been sucked up in peat moss, and lost by evaporation. The result was that streams supplied from these lands after heavy rainfalls—and he had in his mind a basin of some thousands of acres which fed one tributary—had a greater flow of water than formerly after the floods, but the water ran away so quickly that, instead of continuing to flow for weeks, they were left, after a few days, almost dry, except for the water derived from springs.

The question arose whether a mill-owner on that stream who could formerly drive his mill almost continually, even in summer, without having recourse to any artificial storage of water, but now had more water than he wanted and a few days later no water at all, had a remedy against the owner who drained these sheep lands. Another case was that of a private bridge which existed many years, which was too small to accommodate the water, and was supposed by the owner of it to be endangered by the great quantity of water which came down from the drains. Supposing this bridge had been washed away, and that damage to the bridge-owner or the road adjoining the bridge was clearly attributable to this drainage—had he a claim against the person who drained the land? It seemed clear from what Mr. MARRIOTT had said that, in the treating of water under the land, they had a right to turn it off and

carry it away, without returning it to the river from which it was derived.

He thought that mill-dams could be avoided without reference to the owner of the mill. So far as he remembered, an Act of Parliament called the General Outfalls Act had not been alluded to. By that Act, if an owner had not sufficient depth, on account of mill-dams or any other cause, to get an outfall for the proper drainage of his land, he could go through the lands of the adjoining owners lower down the river until he obtained the fall he required, compensating those owners for the damage done in securing the object in view. Thus, he could pass the mill-owner, and so get an outfall beyond him, if it were for the drainage of land. He would not venture to give an opinion on the cause of floods in the metropolis; but, he thought, where streams converged into larger rivers in plains which were frequently covered with flood-water, if the owner on one side made an embankment close to the river-side, which prevented the water going on to his land, it must follow that more water flowed on to the opposite side; but that was a question which admitted of argument and dispute.

The Rivers' Pollution Act had been referred to, and, speaking generally, with regard to that Act, he would very much regret if it proved a dead letter. He was consulted by a department of the Government interested in mineral property, as to the effect the Act might have on that class of property. He felt there was no chance of throwing the Bill out; nor perhaps would it have been desirable, considering the state of such places as Warrington and the towns towards Liverpool, which had something worse than ink and blacking mixed together flowing through them, that it should be thrown out; but he found there were very stringent clauses in it, which, if carried, might put an end

to mining in many districts. The Bill was amended considerably during its passage through Parliament, and was passed in a form much more favourable to the mine owner, if not too prejudicial to the proprietors of property below. In many districts the chief opponents to it were persons interested in fishing in the lower parts of the river. If one took the money value of the individual interest, and not only that, but the value of the wealth of the community and the prosperity of the population, there were many districts in which the mines would be found to be of much greater importance than all the fish between the district and the sea; and he thought it would be a pity if the Act should prove such as to enable the proprietor on the lower water to put a stop altogether to the working of a mine on the higher. He admitted there were many instances in which refuse was thrown into the water, and in which no means were taken for preventing its pollution; and in some cases this formed such immense gravel beds, that there was a great waste of land thereby. He thought those cases needed to be very carefully dealt with, and one must not be too anxious to rush to every mine and stop it, because something injurious went into the water from it.

Mr. J. CLUTTON (Member) wished to say a few words on the subject of sea banks. For a great many years past he had managed some property far below any of the improvements said to cause the damage to London by flooding. The property was situated in the district referred to by Mr. GRANTHAM—the Isle of Sheppey. The banks erected for its protection were in very good condition, and were perfectly effective in keeping out the tidal water, until the occurrence of an exceptionally high tide some two or three years ago. The tide had never previously come up to within 12 inches of the top of the banks; but, on this occasion, it

went over them, and necessitated their being raised some 18 inches or 2 feet. Another tide came, however, which went nearly to the top of this new bank, and he could not help thinking that something more than the meeting of the upland water and the tide was needed to account for the inundations of late years; for, at the same period, when the land at Sheppey—which was beyond the influence of floods, and out of the tideway—was flooded, Lambeth also was inundated; and he could not help thinking, therefore, that these overflows must be due to some cause common to both districts.

With regard to what had been said with reference to under-draining the subsoil, he could point to thousands of acres over which he remembered shooting snipe, when a young man, for days after rain had ceased to fall. He walked, of late years, over the same lands even while the rain was actually falling, and no water remained on it. It was quite impossible to maintain that such a rapid and complete escape of the water could take place without a serious effect in more rapid increase of the floods, and he could not help thinking that, year by year, with the increase of under-draining, the floods would also tend to become greater, and rise more rapidly.

Mr. G. J. SYMONS (Visitor) said that one question occurred to him which some gentleman present might possibly be able to answer, and it was this—Whether the rivers in the lands where under-drainage had been most extensively practised, were more or less flooded relatively to the moorlands which were not drained to that extent? There were many rivers in this country, the uplands on which were very nearly in the same condition as they were fifty or a hundred years ago. In other parts of the country, such as the upper valley of the Thames, the Ouse, the Trent, and many other

rivers, enormous drainage operations had been carried out, and a comparison between the two kinds of district would enable some practical inferences to be drawn. It struck him that, in addition to increasing the volume of water in the rivers, the modern practice of under-draining had also had a further effect, an example of which came under his notice very recently. About a fortnight ago he was asked to go down to Weedon, a Northamptonshire village, through which ran a small brook, which, on several occasions lately, had overflowed its banks. The site of the village was very badly selected, and the damage was a standing warning to people that, if they built upon property in such situations, they must take the consequences of what might happen through their indiscretion. Weedon village was nearly on the level of the stream, which, whenever it flooded, inundated the whole village, and the consequence was ill health and considerable loss of property. In the course of an enquiry by the medical officer, evidence was given that the bed of the stream had risen something like 4 or 5 feet. Now, it struck him that this rising of the bed was due to the increased drainage having washed down a greater amount of silt, and it was not unreasonable to suppose that the same thing had taken place in other parts of the country, for not only did the water run down faster than it used to do, but in much greater quantities also, and consequently carried with it a proportionately greater quantity of solid matter, which was deposited in the bed of the streams when they reached the lower and flatter part of their course.

Mr. C. NORMAN BAZALGETTE (Associate) said that it had been kindly suggested to him that he might, with the permission of the meeting, say a few additional words in reference to the supposed effects of the Thames embankment on the level of the river. He might plead, by way of

justification, that at the last meeting he had confined himself simply and solely to the legal aspect of the question, and declined to go into its scientific bearings, on the ground that they did not arise directly out of the Paper itself. Several speakers, however, had gone into the scientific question, and had dwelt upon it at considerable length, and various arguments had been put forward. If he might venture to say so, his friend, Mr. CASTLE, led the attack. After premising that he had devoted much attention to scientific subjects, Mr. CASTLE had compared the flow of the tide in the Thames to the rushing of a wave up a precipitous beach, ascribing the effects in both cases to what he called momentum. Now, as a man of science, he would ask Mr. CASTLE, what momentum was? He had always understood that momentum was the weight multiplied by the velocity. But velocity was, again, the result of head, and head was the force which filled the river from the sea. Momentum was the final effect, and Mr. CASTLE had, in fact, substituted cause for effect, when he attributed the tidal influx to momentum. The real explanation was simply that, as the tide rose in the sea, and head was formed, so it began to flow into the river, and came up, forcing back the upland water coming down, until that equilibrium was attained called high tide. But mark Mr. CASTLE's argument. He said there was about 16 feet difference between the bed of the river at Teddington Lock and at London Bridge, and that the tidal water came rushing up this inclined plane, urged solely by the force of momentum. To believe that, would be to believe that the water, regardless of the laws of gravitation, came rushing up this 16 feet of rise, instead of endeavouring to find its own level in accordance with the ordinary conditions of nature.

He thought there were three primary causes of flooding. The first was an abnormal rainfall. Now, it had been said

that night (and he could well believe it), that floods had occurred before; but he asked any gentleman to look at Mr. DINES' Rainfall Table (which was hanging in the library, and went back to the year 1813) and pick him out one month in which 6 inches of rain had fallen as it had in December last. It was an abnormal rainfall. There never had been such an amount of rain within a corresponding period. That was one cause. The next cause was the improved land drainage which now brought the rain-waters far more rapidly from the land to the river: and, again, while the volume had thus been increased, no improvement had taken place in the means of running the water off, but on the contrary, the facilities for letting it escape had been actually diminished. Locks and weirs, and everything which tended to obstruct the free flow of the water, were carefully maintained. Did not he read this on the last occasion from Magna Charta, "All weirs shall be henceforth utterly put down by Thames and Medway, and throughout all England?" What was the object? Was it not the same as should be kept in view now that still more water was coming down? The thing to achieve was to get the water off, and low water was the only time that it could escape. If, then, existing obstacles were abolished as far as possible, three times the quantity of water could be run off between the tides, and so much less water pounded back, to cause flooding at high tides. This was the true remedy.

As regarded the Thames embankment, it was a perfectly demonstrable proposition, that no rise whatever had taken place in the level of the river attributable to the construction of that work—in fact, the quantity of water was less now by the exact amount which formerly flowed over the site of the new Thames embankment. It was true that if the tide had to pass up a narrow gorge to fill a large basin or channel behind it, the tide would be heaped up *pro tem.*,

and what was called "a bore" would be formed. But there was nothing of this kind in the Thames. The channel of the Thames indeed was throttled in one place, namely, Southwark Bridge, and at this point a slight elevation of the tidal water would be caused. But so long as the Thames embankment had not narrowed the channel beyond the limits imposed by Southwark Bridge, it had done nothing to increase the surface level of the water. Again, it must be remembered that the lapping over of the tide at Lambeth occurred long before the water reached the Thames embankment. He had no right to dwell longer upon the subject. But so strong was his conviction upon this point, that he felt it was as idle to contend that the Thames embankment contributed to the Lambeth overflow as it would be to argue that driving in a stake at the mouth of the Thames, at Gravesend, had something to do with the flooding of the Christchurch Meadows, at Oxford.

Mr. E. J. CASTLE (Associate) said that his friend seemed to differ with him as to the point on which he (Mr. CASTLE) had ventured to offer a suggestion, viz., whether the Thames embankment, by contracting the channel, had not tended to pile up the water in the stream. To answer this question satisfactorily, it was necessary to remember that the action of the tide was not only due to the tendency of water to seek its own level, but to the fact that, after the tide had been running for some time, the whole length of the stream had acquired motion, so that an enormous momentum had been generated, any opposition to which must have the effect of causing the water to pile up. He referred to the tide at the Channel Isles, which rises to an abnormal height, with great velocity; and to the fact that the tide continues to run up at Teddington for some time after it has commenced to run down at a lower part of the river. He had looked into the

library of the Institution of Civil Engineers, where he had found the result of levels taken in the years 1812 and 1845. One set was taken before the removal of London Bridge, and one afterwards. He had not the extract with him; but, as far as he remembered, the effect was this,—that between Deptford and London Bridge the height of the tidal wave was at its maximum, owing to the narrowness of the river at this point, and the quantity of ships at anchor in the Pool. These facts seemed to him to prove that any diminution in the water way must increase the height of the tide to some extent.

Mr. W. T. MARRIOTT, in reply, said that, before entering into the various points of discussion, he wished to be allowed to thank the members very sincerely for their kind vote of thanks, and for the consideration which his Paper had received. As regarded the several points raised in the course of the discussion, he was quite willing to leave the scientific question to Mr. CASTLE and Mr. BAZALGETTE. Before he came to the case of the metropolis, he must say a word on what fell from Mr. WILLIS BUND. He did not know what the particular Acts were to which Mr. BUND had referred; but his complaint seemed to be that the Acts authorizing certain works from which he had suffered, left him without redress for the damage inflicted. Compulsory powers for works were generally accompanied by provisions insuring compensation for substantial damage caused; but, if the Acts to which his friend referred were private Acts, he could only say that, if people locally affected did not look after their own interests when the Acts were being passed through the House, they had only themselves to blame. So far as he was aware, there was no such thing as a public Act giving compulsory powers without giving

adequate powers for paying compensation to those injuriously affected.

The few words he had bestowed upon the Rivers Pollution Act in his Paper were certainly of a very mild description, and hardly justified Mr. BUND's remark that he had not the same faith in that Act as he (Mr. MARRIOTT) had. He went no further than saying that the Act held out some hope of an effectual remedy; and this he thought was the case.

He thought that Mr. BAZALGETTE had misstated the law on two very important points—points which affected the whole of the question. He would read Mr. BAZALGETTE's words as he found them printed. They were as follows:—"Then there was the remarkable case of *Hudson v. Tabor*, which was decided in the Queen's Bench, and was now being carried up to the House of Lords, and the general effect of which was to confirm the principles of the joint liability of the owners of the flat in the absence of special usage, though special usage and prescription could saddle any frontager with the special responsibility." He must say that he understood the decision in an entirely different sense—as being this, that there was no liability whatever upon the riparian owner, unless it could be shown that he or his predecessors had incurred the liability in former times for some consideration; and, as Lord Chief Justice Cockburn said, "Why should there be? It would be very hard for a poor man to be bound to protect a rich man." No duty was implied, unless it were duty by prescription; and duty by prescription meant this (the mere fact of proprietors having put up a sea wall and maintained it for even a thousand years was not a duty by prescription), that it must be shown that what was done was done for the benefit of neighbouring owners, and in return for some

consideration. Therefore, he thought the view which Mr. BAZALGETTE entertained was absolutely erroneous. The fact was that a riparian owner, as such, had no duty whatever thrown upon him.

It was said by Mr. BAZALGETTE, when referring to the Lambeth floods, that the Vestries were appointed under the Metropolis Local Management Act, 18 & 19 Vict., c. 120, as the proper authorities to raise and repair banks and wharves to keep out the floods, and that, under section 70, they could charge the expense partly on the riparian owner, and partly on the district; that was to say, it might be divided between the individual and the rates. He then said that WOOLRYCH's footnote pointed out that "there is some difficulty attending the mode of proving and enforcing liabilities of this nature, under the present Act." Now, he had with him the complete clause, and it seemed to him to bear a very different construction as to riparian owners. The clause was this—"Wherever any party is, by prescription, by reason of tenure, or otherwise, liable by law to maintain or do any repairs to sewers, banks, watercourses, or works, in any such parish or district, which the vestry or district board judge it necessary to alter or improve, it shall be lawful for them to make such alterations or improvements therein as they think proper, and to divide the expense of such alterations or improvements between the party liable to such maintenance or repairs, and the parish." The difference between this and what Mr. BAZALGETTE had said, would be at once apparent. It was quite possible that the riparian owner might be liable, by prescription or otherwise, but no riparian owner was liable, on the other side of the Thames or elsewhere, unless by prescription, or by reason of tenure. Therefore, he did not wonder that the Lambeth Vestry was in a difficulty, for who was to decide liabilities of the kind? It would be necessary to obtain evidence and go before a jury,

and that meant an uncertain decision after great expense had been incurred. This was the position of the Vestry of Lambeth at the present moment.

He now came to what he thought was of more importance, namely, the policy of the matter. The Metropolitan Board had shirked this particular duty with a modesty of which this was a first example. They had been formerly ready to take any additional duties, and enlarge their powers to any extent; consequently, he was at a loss to understand their reluctance on the present occasion. He commended to their attention the reasoning of Lord Chief Justice Cockburn in *Hudson v. Tabor*. "Because a man held a small piece of land which was valueless, the law threw no duty upon him as a riparian owner to protect the property of those behind him." As a matter of policy he would suggest that the embankments of the river were better under the Metropolitan Board than under the care of private owners, bearing in mind the fact that those on the edges of the land had no more duties upon them than those in Belgravia or Golden Square.

THE PRESIDENT desired to make but two observations on the discussion. Firstly. He thought that Mr. CASTLE's theory was deserving of attentive consideration. In the river Severn the tidal wave, confined in a narrow channel, rises at Nuneham several feet, and rushes up the river, as a wall of water, at the rate of 8 miles an hour, until it reaches the level of its head. The Aegre, in the Humber, is of less height but of the same nature, and similar effects are produced in the Seine and in other rivers. The extreme instance was in the Bay of Fundy, where the tidal wave rises to a height of 70 ft. The fact was certain that the tidal wave rose to an abnormal height in a confined channel.

Secondly. He concurred with Mr. CLUTTON that efficient

underground drainage brought the upland waters to the sea earlier and more simultaneously. The Yorkshire Ouse had a continuous fall from the Penine Hills to the tide level, and the effect was more clear, perhaps, on that river than on any other. The precise reason for underground drainage was that the rain waters might be carried away more quickly. The chief want as regards inundations was an efficient control over the maintenance of the river banks; and Local Boards should see to the state of every bank along the course of every main river. The present inundations on the Parret, the Yorkshire Ouse, the Trent, and the Witham, were in each case occasioned by broken banks—the chief danger being where the tidal wave prevented the upland waters from descending further towards the sea.

The Meeting then adjourned.

Shetland Is

Fair I.

HYDROGRAPHICAL MAP OF THE BRITISH ISLES BY G.J. SYMONS F.M.S. &c

REFERENCE.

Land on which the Annual Rainfall is less than 25 inches
between 25 & 30
30 to 40
40 to 50
50 to 75
more than 75

The progress of the Tidal Wave
in hours is shown thus



RAINFALL, AND ITS RELATION TO CIVILIZED LIFE.

By G. J. SYMONS, F.M.S.

*Read at the Ordinary General Meeting of the INSTITUTION OF SURVEYORS,
February 12th, 1877.*

THE PRESIDENT IN THE CHAIR.

I HAVE felt it necessary to limit the primary subject by the second title, in order to avoid that partial and superficial treatment which would have been inevitable had I attempted to consider rainfall in its meteorological and physical aspects as well as in its practical ones. I therefore purpose omitting all *unnecessary* references to meteorological matters, and showing in how many ways a knowledge of the rainfall, or of the quantity of water naturally precipitated over any given locality, is of importance to every civilized being.

It will materially assist the full appreciation of the main object of this paper if a little time be devoted to a somewhat elementary sketch of the mode of measuring the rainfall and of recording it, the arrangements in operation for collecting and publishing the returns, and, finally, some of the broad general results obtained.

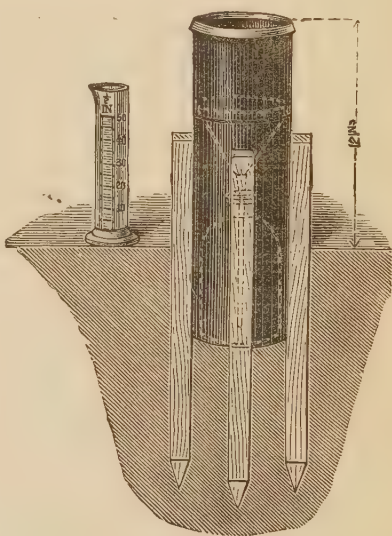
If the entire surface of the country were a horizontal slab of slate, the rain falling upon it would cover it to a certain depth, because none could percolate and none could run off; the depth of water would be the depth of rainfall, and a rule plunged vertically into it would show that depth in inches, millimetres, or whatever scale was marked upon

it. Happily for mankind, the surface of the country is not horizontal, nor is it composed of a uniform bed of slate; and therefore, as well as for many other reasons, rain-gauges became necessary. There are too many varieties of pattern of rain-gauges, but fortunately there are very few bad ones, and they are rapidly being abandoned. All patterns of rain-gauge are intended to act as rain-traps—*i.e.*, to receive all the rain which falls within their receiving-surface, but not to allow any of it to escape by evaporation. In some cases this is effected by covering the contained water by a float, in others by making the only connection with the atmosphere take place through a long narrow tube.

Having collected the water, the next thing is to measure it. The mode of doing this depends chiefly upon the locality in which, and the circumstances under which, the gauge is to be used. For instruments adjacent to residences, in gardens,

parks, &c., the most usual and the best form is that shown in Fig. 1, where (tracing downwards) we have, first, a brass rim turned in a lathe so as to ensure its being a true circle, as well as of the proper area (usually 5 inches diameter = 19.635 square inches area, or 8 inches diameter = 50.266 square inches area); then a plain cylinder about 5 inches deep, to afford storage for snow; then

FIG. 1.

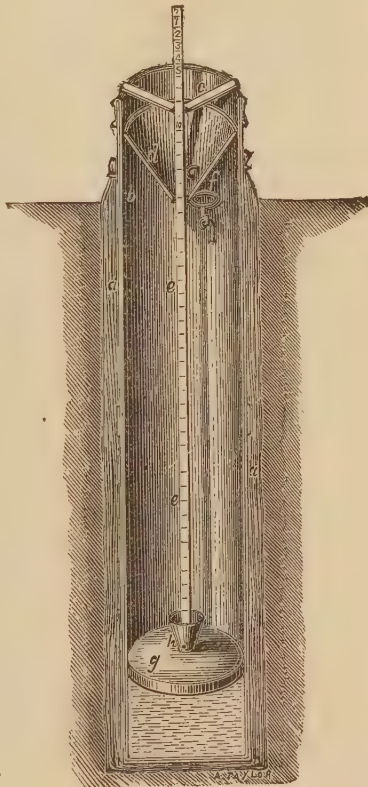


a sharp cone, ending in a long, narrow pipe, to convey the

water into the bottle, in which it remains until the time for measurement. Out of the bottle the water is poured into a jar about $1\frac{1}{2}$ inches in internal diameter, whose area is, therefore, 1.767 square inches—or say, $\frac{1}{11}$ th of that of the receiving area. Obviously, if the quantity of water is such as to fill this glass jar $5\frac{1}{2}$ inches deep, the depth over the area of the rain-gauge has been $\frac{1}{11}$ th of that, or just half an inch deep.

Where, however, a rain-gauge is required for use on a moor or other place, where it can only be visited and examined at intervals of a week, month, or more, less precision of measurement is necessary, and strength, facility of use, and non-liability to injury, are principally aimed at. Fig. 2 represents the pattern of gauge designed by me in 1866, for use at various stations on the Cumberland mountains. It consists of a double cylinder, the inner one exactly 8 inches diameter, and surmounted by a turned brass ring as its receiving-surface. The gauge being of equal area throughout, it is obvious that the water will stand in the cylinder at what may be called its natural depth, viz., that of the actual fall of rain. Resting upon the surface of

FIG. 2.



the water is a hollow metal float, which nearly covers it, and thus prevents evaporation, while at the same time it indicates the depth of the contained rainfall, since it stops the descent of the detached measuring-rod dropped in, to ascertain the total amount in the gauge.

It will probably be desirable to state, in the form of an Appendix, at the end of this Paper, the principal rules which have been drawn up for the guidance of observers.

Measurements in conformity with these rules are now made daily at upwards of 1,500 stations in the United Kingdom, and at longer intervals, weekly or monthly, at about 300 others. These stations are shown upon a map which I exhibit. It will be seen that although there is a tendency to increased closeness of stations around the centres of population, and in the manufacturing districts, there is nevertheless a very fair general distribution throughout the Kingdom. At the same time it is evident that additional stations are needed in parts of north-east Yorkshire, Wales, Scotland, and Ireland.

The records, or rather copies of the records, at all these stations are forwarded regularly to me. With the assistance of a small staff I verify them as much as possible, and publish the results. Originally, the entire cost of collection, verification, and publication was defrayed by myself, but in consequence of the enormous development of the rainfall organization, it was found necessary to invite subscriptions in aid of the expenses, and also to charge for some of the publications.

Passing now to results. The most important is also the most difficult to ascertain, viz., the true mean rainfall of any given locality. If a person requires for any particular purpose to know the mean rainfall of a certain place, it is of little use for him to buy a gauge, and have it observed with great care, and for this reason:—the rainfall varies so

greatly from year to year, that he may, in a locality of which the true fall averages 30 inches, measure 20 inches or 40 inches in one year; and even if he can wait two years for his information, he may have 20 inches and 30 inches in one case, giving the average of 25 inches, or 30 inches and 40 inches in another, giving the average of 35 inches; that is to say, in any locality, the rainfall of a single year may be 33 per cent. either above or below the true average, a two years' average may be $16\frac{1}{2}$ per cent. above or below, and so on, the approximation decreasing less rapidly, so that at the end of ten years, the average will probably be within 5 per cent. of the true mean of a long series of years. These facts prove two points, first, that in all cases where even in the far future there is possibility of contention as to the fall of rain, whether as regards water rights, drainage, floods, or what not, it is good policy to commence a record, as it would be fifty times the value of any that could be commenced when the necessity arose. Secondly, it shows that where a knowledge of the mean rainfall is required, the best plan is to consult the records of the past. The accompanying map is reduced from one prepared by me some years since, and published in the Sixth Report of the Rivers Pollution Commission; it is not therefore so perfect as could now be prepared; but the labour of revising it would be very considerable, and it will probably be better that it should not be attempted until the close of the decade 1870-79. The author trusts that it is so plain as to render any comments unnecessary, except as previously implied, that it is one great object of rainfall observation to determine with greater accuracy the true direction of the various lines which in this map are only approximate.

Besides acquaintance with the total rainfall per annum, it is useful, and occasionally important, to know the relative wetness of different months; but this fluctuates so very

greatly that neither averages nor extremes can be computed with accuracy. Taking the country generally, July and October may be regarded as the wettest months—July owing to the very large amounts which often fall during thunderstorms, and October from frequent steady rains; while the least fall occurs in April or May. The absolute limits of the monthly fall have not been determined, but they are probably *nil* as the minimum, and 30 or 40 per cent. of the yearly average as the maximum.

The fall in a single day is a matter of great importance, and, fortunately, its probable amount has been approximately determined. It is a singular fact that the amount which will be the extreme and absolute maximum, not merely of one, but of many years—perhaps fifty or a hundred years—is one which appears to be almost independent of locality or of mean annual rainfall. It appears, from the facts communicated to me, that there is no part of the kingdom which is not liable to a fall (once in a century, perhaps, and even then only over a very small area) of more than 3 inches. Even 4 inches in twenty-four hours, in dry districts, fall occasionally—*e.g.*, 3·95 inches fell at Letheringsett Hall, Norfolk, on July 20th, 1875; 4·11 inches fell near Liphook, Hants, on July 31st, 1872; 4·24 inches at Melbury, Dorset, on August 14th, 1871; 4·27 inches at Macclesfield, on June 18th, 1872; while, on July 14th, 1875, the average fall over Monmouthshire was quite 5 inches in twenty-four hours.

Even heavier falls than these occur over small spots on excessively rare occasions; but the cause then seems to be not true rain, but the bursting (or, more properly, the deposition of the contents) of a waterspout. The maximum which may fall under those circumstances is unknown, rain-gauges rarely being in the identical spot. Something of the kind occurred at Scarborough, on August 6th, 1857, when the

rain-gauge, which held $9\frac{1}{2}$ inches, was filled and ran over. Very serious damage usually results from these occurrences, but fortunately the area injured is generally small.

WATER SUPPLY OF TOWNS.

Water-supply naturally claims the first consideration in our inquiry respecting the practical application of rainfall statistics. Every inch of rain gives 22,623 gallons of water per acre, or $14\frac{1}{2}$ million gallons per square mile. This is really the fact which forms the basis of all calculations respecting water-supply, whether it be for a large town or a single house.

It will not, however, be safe to regard the mean annual fall of rain as the quantity actually available. Of the entire quantity of rain falling in any given locality, some is evaporated, some flows off the surface, and some percolates to feed the subterranean springs; and the amount passing in each direction depends upon a variety of causes. The estimation of these proportions is very difficult; the evaporation is greater in some districts than in others, and in some years than others; the flow off the surface depends upon its slope, the nature of the soil, and the distribution (in time) of the fall of rain; while, thirdly, the percolation is partly the complement of the last-mentioned series of facts, and partly dependent on the level of the water in the soil. To the foregoing difficulties must be superadded, in the case of storage reservoirs, the fact that excessive rains, which tend to raise the mean annual rainfall, occur at such long and irregular intervals as to render it cheaper to rely upon a large area, and allow these exceptional rains to run to waste, than to construct works for holding all the water which falls upon the smaller area.

Without entering into the full details, it may be well to state the rough rule which (rightly or wrongly the author

does not here stay to discuss) has been frequently acted upon with reference to large schemes of water-supply. Take, for example, an ordinary Yorkshire moor, with a rainfall averaging 40 inches, and a total loss, from evaporation and percolation, of 12 inches. The calculation has often been made in the following form:—

Mean rainfall	40·0 inches.
Deduct, for floods and unstorable water	6·6 „ or $\frac{1}{8}$ th.
	33·4 „
Deduct, for evaporation and percolation	12·0 „
Available rainfall	21·4 „

This, according to Parliamentary usage, would be allotted, two-thirds to the party making the reservoirs, and one-third to the stream.

I believe that this division of the available water has no other basis than usage, and it appears to me that a rule ignoring, on the one hand, the very various nature and cost of the works, and, on the other, the varying extent to which different streams are, or can be utilized, is far too rough for universal employment, as is at present the case, even works costing a million or more sterling being apportioned by this rough-and-ready rule.

Another respect in which the existing mode of Private Bill legislation is creating rights of very doubtful public expediency is the granting of absolute water rights over large tracts of land to the first body, whether company or corporation, which asks for them and comes to terms with the landowners, and with the millowners on the stream. Surely, the wise and proper course would be to stop the present scramble, in which the wealthy and the venture-some have it all their own way; to have a careful survey made of the still unseized lands available for gravitation

waterworks, and then (subject to all proper payments by the parties taking them) let them be appropriated to the various communities in conformity with their proximity and with their requirements.

WATER SUPPLY FOR COUNTRY MANSIONS.

Where the supply of a mansion is to be taken from a stream, the arrangements are similar to those for town supply, except that they are much smaller, and that some modes of raising water are available for small works, but unsuited for large ones. For example, hydraulic rams are excellent for house supply, but only deliver from $\frac{1}{4}$ th to $\frac{1}{20}$ th of the water passing through them, and are, therefore, much too wasteful for town use. Similarly, force pumps driven by windmills are very economical and suitable for house supply, but would be ridiculously inadequate for town works. The objection that the windmill system is liable to fail for lack of wind is of little weight, because (1) there ought to be adequate storage at a high level to last during a calm, and (2) if there be not, horse gear may easily be arranged to supplement wind force when needed, or in lieu of it. A very neat arrangement of this kind is made by MAGUIRE & SON, of Dublin.

It is frequently necessary to rely upon the collection of rain water from the roofs for the supply of the residents beneath them. Many great errors have been committed in estimating the probable yield from each square yard of ground covered by buildings. It will, therefore, be well to mention some of the points upon which mistakes have been made. The amount of rain reaching the ground is considerably greater than that which falls upon any building, or even than falls into a rain gauge mounted on a pole; but the larger the house the less the deficiency on its roof. It is unnecessary to raise here the question of the reason for

this decrease. The cause is not perfectly known; the fact is. The quantity of water collectable from a roof depends partly on the pitch, and partly upon the material of which it is formed. Very heavy rains may occur when the tanks are full, and so be lost. An inch of rain gives 4·67 gallons per square yard. The calculation would be *approximately* as follows:—

Style of architecture. Elizabethan.

Area of ground plan (110 ft. $\times$ 30 ft.) 3,300 feet.

Mean annual rainfall, 36 inches.

Mean height of roof, 30 feet.

Mean annual rainfall at one foot

above ground 36·00 inches.

Deduct for height of roof (30 ft.),

11 per cent. 3·96 „

Mean fall on a flat roof . . . 32·04 „

Deduct for high pitch roof (?) 3 per

cent., and for absorption by

tiles (?) 2 per cent. 1·60 „

Mean fall on roof 30·44 „

Deduct for excessive rains at times

when cisterns are full, $12\frac{1}{2}$ per

cent. 3·81 „

Available rainfall from roof 26·63 „

Then it is only necessary to multiply together the area of the roof, 3,300 square feet or 374 square yards, the available rainfall in inches, and the yield of each inch in gallons per square yard, to ascertain the total amount collectable from the roof. Thus $374 \times 26·63 \times 4·67 = 46,513$

gallons per annum ; but this is only 127 gallons per diem, a wretchedly inadequate supply for the inhabitants of a house 110 feet long by 30 feet deep. It is often stated that if *all* the rain which falls upon *any* English house were preserved, it would give an ample supply of water for the inmates. The map shows that over a considerable portion of eastern England, the rainfall on the ground averages from 20 to 25 inches. Granting temporarily that all the water could be collected ; that as much rain falls on the roof as on the ground ; considering, in fact, that the house was a perfect rain-gauge, what would be the supply ? It would be 93·4 gallons per annum per square yard, with a 20-inch rainfall, or 117 gallons with a 25-inch rainfall. For a cottage 15 feet by 12 feet this would give 5 gallons per day in the first case, and $6\frac{1}{2}$ in the second. This is, probably, not $1\frac{1}{2}$ gallons per head for the inhabitants, or, in other words, not one-tenth of what is usually considered necessary.

Another aspect of the supply of water to detached country houses, is that of adequate provision against fire. The frequently adopted plan of making a cistern on the highest part of the house—the sheet anchor of the fire prevention system—appears to me to be unsafe.

Fires are most probable, and overheated flues most frequent during frost, when a roof cistern may contain little except ice. A roof cistern can rarely give sufficient pressure to extinguish a fire upon a roof, yet fires often commence with the plumber's fire pot. People rarely know whether a roof cistern is full or empty, and the fact can only be known by an indicator or by inspection. The mere discharge of a jet from a hydrant on the basement proves little more than that there is water in the pipe, for 10 gallons in the cistern would give nearly the same pressure as 100. Where no other plan is practicable, the above criticisms may be useful as suggesting modes of avoiding evils.

It is much better, however, to have a small reservoir on higher ground than the house, with a main from it, so that the whole system is independent of frost. This reservoir should be so arranged that nothing but the firemain can take away the last few thousand gallons. By this means a failure of supply is impossible. In order to insure adequate pressure, and to compensate for the friction of the water in the main, the bottom of the reservoir must be at least as high as the tallest chimney of the house.

My acquaintance with agricultural operations is insufficient to enable me to discuss properly the important relations of rainfall and crops. It is obvious that the latter almost wholly depend upon the former, and I have constant proof of it in inquiries by agriculturists as to the rainfall of districts in which they purpose to reside. The relations, moreover, appear so natural and obvious that it often puzzles me why failure is so frequently invited by people attempting to raise crops in localities utterly unsuitable for them. While recognising fully that agricultural drainage has added millions to the productive power of the country, I believe that in many districts it has been carried to too great an extent. This is especially the case in the undulating districts of the Midland Counties of England, whence, every dry summer, there comes a wail of distress about droughts—droughts created by man's neglect of the most elementary conditions of physical geography. Nor is it the crops alone that suffer; the people suffer also. Drainage has hurried the rain into the rivers; temporary floods are followed by half-empty streams; six or eight weeks' dry weather leaves but a few pools of stagnant, unwholesome water, and water fit for drinking has often to be carted many miles.

Another point, which is perhaps hardly sufficiently considered, is the relation of rainfall and drainage to the effect

of manure. Take an extreme case. A thoroughly-drained field of autumn-sown wheat is heavily manured; the plants are so small that they can assimilate but little of the food provided for them; heavy rain falls, pours rapidly through the soil into the drains, and, instead of the manure remaining in the ground, it is washed into the streams, and, instead of fertilizing the crops, it contaminates the water-supply.

These two aspects of the great question of agricultural drainage afford strong confirmatory evidence in favour of the argument, that when man tries to alter natural conditions he must look very far ahead, or he may find that he has incurred one evil through clumsily trying to cure another.

APPENDIX.

RULES FOR OBSERVERS.

A rain gauge should not be set on a slope or terrace, but on a level piece of ground, at a distance from shrubs, trees, walls, and buildings—at the very least, as many feet from their base as they are in height. Tall-growing flowers, vegetables, and bushes must be kept away from the gauge. If a thoroughly clear site cannot be obtained, shelter is most endurable from N.W., N., and E., less so from S., S.E., and W., and not at all from S.W. or N.E.

The funnel of a rain-gauge must be set quite level, one foot above ground, and so fixed, by three or four pegs, that it will remain firm in spite of any gale of wind or ordinary circumstance

The gauge should be emptied regularly each day, at 9 a.m., and the amount then measured entered to the day before that of measurement.

The measurement simply consists in emptying the contents of the bottle into the glass measure (which must be held upright), and noting the number of the division to which

the water rises. Each division equals 100th of an inch; the fifty divisions, therefore, equal half an inch—that is to say, one division should be entered as $\cdot 01$; 25, as $\cdot 25$; and 50, or half an inch, as $\cdot 50$; of course, if there is more than that, it must be measured separately; for instance, twice full up to the 50 and once to the 6 would be

$\cdot 50$

$\cdot 50$

$\cdot 06$

1·06 or one inch and six hundredths.

The amount should always be written down before the water is thrown away.

All columns should be cast up *twice*. When there is no rain, a line should be drawn rather than cyphers inserted.

When very heavy rains occur, it is desirable to measure on their termination, and enter the particulars as remarks, and it will be found a safe plan after measuring to return the water to the gauge, so that the morning registration will not be interfered with. Of course if there be the slightest doubt as to the gauge holding all that falls, it must be emptied, the amount being *previously* written down.

In snow, melt what is caught in the funnel, and measure that as rain, and select a place where the snow has not drifted, measure with a rule the average depth, and enter it in the remarks.

G. J. SYMONS.

62, CAMDEN SQUARE, N.W.

Mr. F. VIGERS (Member) had much pleasure in proposing a vote of thanks to Mr. SYMONS for his excellent paper—a vote in which he was sure all would concur, for, in these days, when the question of water supply was coming

so prominently to the front, every addition to the general stock of information on the subject was most welcome.

He must confess that he had an impression before hearing Mr. SYMONS' paper, that almost every country house, if provided with a sufficiently large tank to receive the whole of the rainfall from the roof of the house, would, irrespective, of course, of the special supply for drinking and similar purposes, be tolerably well off for water. It was possible, however, that he had been labouring under a mistaken impression.

He was not quite prepared to agree with the remarks made by Mr. SYMONS with reference to the alleged over-draining of land in some parts of the country; neither did he believe that the rain which fell on the surface ran at once into the subsoil drains, the fact being that on well-drained land, little, if any, of the rain which fell on the surface passed directly into the drains, but was held in suspension in the land, until the soil became overcharged. It then passed gradually down, until it met with some obstruction more or less impervious, when it commenced to rise, and did so until it reached the bottom of the drains. In other words, he believed that it was in its ascent, and not in its descent, that it got into the land drains at all. This fact was familiar to those concerned in the drainage of land, who found from experience that the deepest drains ran first.

Mr. E. RYDE (Vice-President) had much pleasure in seconding the vote of thanks.

The paper was too technical to admit of discussion without some previous consideration: but there were one or two points upon which he would offer a word or so of comment. The fact, he supposed, was familiar to meteorologists but he was certainly struck with Mr. SYMONS' assertion that less rain fell upon the roof of a house than

would fall upon the area of ground occupied by the house if the house were not there, and he hoped to hear some explanation of this mystery in the course of the discussion.

The great question to be solved by the next generation was, how to store up the surplus water which fell in times like the present, and which did so much actual damage. In the case of any species of produce it was customary to store up the surplus instead of consuming it at once, or allowing it to be wasted. It was surely a matter of equal importance to store water in times of excessive rainfall to provide for periods of scarcity.

The Rev. J. C. CLUTTERBUCK (Visitor) said, with reference to the difficulty commented on by Mr. RYDE, that an old schoolfellow and friend of his (Professor JOHNSON, of the Radcliffe Observatory at Oxford), was, he believed, the first, many years ago, to call general attention to the fact that there was more rain received at a certain elevation than on the ground. He advised Mr. RYDE to provide himself with two rain-gauges, one to be placed at an elevation of 25 or 30 ft. above the ground, and the other upon the ground, and he thought he would find a very considerable difference between the quantities recorded by the two gauges.

With reference to the amount of water caught upon the roofs of houses, the quantity depended very much upon the material with which the roof was covered, as he had found from observation. So far as he could judge in a rough manner, he had come to the conclusion that slates would give off in a shower of rain, an amount of water which tiles would retain. He had found that something like 300ths of an inch of rain must fall before the tiles would throw water from their surface, and in hot weather the difference in this respect between the two materials was very considerable, the tiles, in summer, becoming comparatively dry between the showers.

For many years past he had tried to connect the rainfall with the subterranean water. Mr. DICKINSON, and after him Mr. EVANS, his partner, had had a large business in Hertfordshire as paper-makers, and, in order to ascertain the quantity of water available for power for the mills, had been in the habit of using what was known as the Dalton rain-gauge. He (Mr. CLUTTERBUCK) thoroughly believed in that gauge up to a certain point, and had records of it extending over a great many years, and in the Paper read by Mr. SYMONS before the Institution of Civil Engineers there were some observations made, by the gentleman he had mentioned.

With regard to the subject generally, he might be pardoned for mentioning that about the year 1850, he read a Paper before the Institution of Civil Engineers, at the suggestion of his late friend, Dr. BUCKLAND, on the subterranean water of London, feeling that the country at large was not sufficiently informed as to the connection between geology and the water supply. People were apt to take a large surface and argue that a certain quantity of water fell on that surface, and therefore that so much sank into the earth, and the remainder flowed away or was lost by evaporation. Now, if the whole surface of the earth were of the same character, it would, perhaps, be possible to measure the quantity which sinks into the earth with an approach to exactness; but when it is found that in every acre of land there are some variations in the character of the soil, though, perhaps, of the slightest possible kind, the amount was not so easy of determination. He ventured, at the close of the discussion upon the Paper on the subterranean water of London to which he had referred, to express his regret that there was not some staff appointed by Government to examine these questions, and endeavour to trace the connection between rainfall and geology. It

was idle to suppose that anything whatever could be known about the effect of the rainfall on the earth without a fuller knowledge of the construction of the earth itself. This was a work for Government to do, inasmuch as it was not everybody who was competent to undertake or had the necessary liking for, or means of undertaking work of the kind. He recollected speaking to an eminent friend of his, the late Mr. JAMES SIMPSON, who understood the question of subterranean water far better than any other man he had ever met with, and his reply to a suggestion that an investigation of the kind which he had been advocating should be made, was, "It is all very well to tell us to make such and such investigations, but they do not pay: amateurs may make them, but professional men cannot afford it." It was for this reason that he thought a Government staff should be appointed to pursue this most difficult but important investigation. For instance, in the course of an enquiry held at Oxford he had recorded his opinion in evidence that there was a vast quantity of water which found its way out of the chalk into the Thames, between the places where the river entered the chalk, and left it somewhere below Maidenhead. The truth of this was afterwards demonstrated, a fact not generally known.

As to storage of water, he was at a loss to know how it was to be accomplished. People were ready enough to talk about the desirability of storing it, but he never yet met with any one who had a practical plan for doing so. In the valley of the Thames, for instance, which traverses a great variety of strata, through some of which, as in the case of the Churn, in Gloucestershire, the water absolutely disappears in dry seasons, there were only a few localities suited for the purpose. The strata of the upper part of the Thames valley were, in some cases, adapted for the storage of water, as was proved by the reservoir called the Boddington reser-

voir, which supplied the upper levels of the Oxford canal, and the supply to which depended on the nature of the stratification. No doubt there were other parts of the Thames valley where water could be stored, but, speaking in a general way, he doubted whether efforts directed towards this object would be attended with success.

Mr. R. B. GRANTHAM (Associate of Council) could bear testimony to the value of the researches carried on by Mr. SYMONS, having had occasion to apply to him for the statistics of rainfall on particular areas with which he had been called upon, as an engineer, to deal. He could not help thinking, however that, for engineering purposes at any rate, the figures given by Mr. SYMONS would be still more useful if they did not represent averages only, since works were planned with regard to the maxima and minima of local requirements. As regarded the water-supply of towns, the question of the proper amount of water per head of population was one which must be governed mainly by local considerations; but a sort of rule had been established, which was acting very fairly, viz., that in towns situated in agricultural counties the allowance should be 25 gallons per head per day, and in the manufacturing districts that there should be a larger supply, regulated by the kind of manufacture carried on in the place; this would in some instances amount, perhaps, to 100 gallons per head per day, as was actually the case, he believed, with Manchester and some other towns.

He did not agree with Mr. SYMONS that hydraulic rams were "excellent for supplying water to country mansions." They were very wasteful for any extensive purposes, as Mr. SYMONS had pointed out, more especially if the supply of water was limited. A windmill, again, was very uncertain, and frequently required horse-power as an

auxiliary. He thought that in all cases where 3,000 or 4,000 gallons per day were required that steam-power should be employed, since it could be used in many other ways when not required for pumping—for grinding, sawing, and so on.

It was argued by Mr. SYMONS that though subsoil drainage had added millions to the productive power of the country, lands were, in many cases, injured rather than improved by it. He (Mr. GRANTHAM) could only say that he had never met with a case of the kind in the course of a somewhat long experience, either in the Midland counties or elsewhere.

It was for the engineer to devise means of storing up the water which now ran to waste, and keep the main channels of the rivers free for carrying off floods and excessive rainfall. It should be remembered that the object of what was called the pipe drain system was not to drain off the rainfall, but the subsoil water, which was far more injurious to vegetation, and which, as Mr. VIGERS had correctly said, got into the drains from below. In order to reach this water it was necessary to drain, in some cases, to a depth of 3, 4, 5, and 6 feet. He had never known but one instance of water washing the manure out of the ground into the drains, and that was on a sewage farm where, owing to particular circumstances, the soil had cracked and allowed the sewage to pass through unimpeded.

Mr. J. LUCAS (Visitor) said that he remembered a water-spout (he believed, in July 1872) which burst on Great Whernside, one of the Yorkshire hills, and swept away a vast amount of property in Coverdale, demolishing, among other things, a semicircular bridge in Nidderdale, which had withstood the floods of 200 or 300 years. With regard to the length of time necessary to store water, he might observe that he had once taken the trouble of going through

the figures of the Greenwich rainfall ranging between the years 1815 and 1868, and he found that the average of the first nine years was considerably in excess of the mean quantity for the whole period, in these years 41 inches being recorded as having fallen in excess of the mean for the whole period. Meteorologists contended that the records of these nine years were too high, and that the rain was inaccurately measured. Be that as it might, it was a fact that in the year 1854, a period of drought commenced which lasted five years. The total defect, in inches, below the mean, during that five years, was 28, and if gravitation water works, based on an average of the whole period, had been erected in the year 1815, they would have failed in the year 1858, simply because, although the defect below the mean in the five years 1854-1858 was only 28 inches, the gradual loss which took place during the intervening 30 years or so was more than sufficient to counterbalance the difference between the 41 inches and the 28 inches. He was aware that no deduction was made in that calculation for evaporation, and he merely gave it as an illustration to show the length of time for which it would be necessary to keep rain water in order to secure an average supply.

The quantity of water discharged by land drains in a wet season was something extraordinary, and a person who did not know the position of the drains would suppose that they were strong springs. Last December, and no doubt at the present moment, these land drains were running with great force. He did not believe in the theory enunciated that the water first descended and then rose into the drains, for in many cases they were situated in clays which decomposed and formed a soil capable of holding a large quantity of water.

Without going into the question of the penetration of rain, he might mention the fact that, in the month of

December last, in the chalk wells, there was a rise of something like forty feet within the month, or more than twelve inches in a day.

Mr. G. D. YEOMAN (Member) would be glad to ask Mr. SYMONS a question. That gentleman had stated that the rainfall on the ground was in excess of what would fall upon a roof of similar area, but he did not give the reason. He would like to ask whether, supposing that the whole shower of rain fell on one single acre of ground, and a precisely similar shower upon an acre of reservoir at a higher level close by, the rain which fell on the acre of ground would be more than that which fell on the acre of reservoir? If that were the case, did Mr. Symons account for it by the theory that the drops of rain, singly (and therefore collectively as showers), increased in size as they got nearer and nearer to the surface of the earth.

Mr. A. HAVILAND (Visitor) observed that the practical form which Mr. SYMONS' observations had taken from the commencement was now bearing fruit, and was likely to prove of immense service throughout the country. As a Medical Officer of Health, he found frequent advantage from Mr. SYMONS' researches, in connection with enquiries into the effects of floods upon the health of the population. His own study of the geographical distribution of disease, convinced him of the importance of this subject in relation to preventive medicine, and much credit was due to Mr. SYMONS for the care with which he had sifted and analyzed the mass of figures presented annually for the purposes of his rainfall investigations.

Mr. WILLIAM EVE (Member) inquired whether, in the statement which had been made—viz., that more water was

produced from flat roofs than steep ones—any allowance had been made for extra absorption on flat roofs, or whether it represented the amount of rain which actually fell.

Mr. G. J. SYMONS, in reply to the discussion, begged to express his sincere acknowledgment of the cordial reception given to his Paper. So little exception had been taken to his facts that his remarks would occupy but a very short space. First, as to effects attributed by him to the drains in some descriptions of land. As he had explained, he was no agriculturist, and it was possible that he was wrong in supposing that a good deal of manure was carried away by subsoil drains. He based his theory (for it was nothing more) upon the following facts, which had come under his notice. About two years ago he had the privilege of visiting the experimental farm of Messrs. LAWES and GILBERT. Among other things his attention was attracted to a field of wheat, one plot of which had received its manure in the autumn, and the other in the spring. They were adjoining plots, and had each received precisely the same quantity of manure, though, as he had said, at different periods of the year—in the one case a single dressing, and in the other a double one; and it so happened that the autumn and the winter had both been extremely wet. Messrs. LAWES and GILBERT analyzed everything which it was possible to analyze, and among other things they analyzed the effluent water from the drains on the farm, and found that it contained a certain percentage of the manure put on the land. The contrast between the two plots was very remarkable. The plants in the one were sickly and miserable, and in the other perfectly healthy; and he jumped to what he could not help considering the very reasonable conclusion, that some of the manure had been washed into the drains.

With respect to relative amounts of rainfall on house-

roofs and on the ground, he might mention that more than a century since, Dr. HEBERDEN, who was much interested in the rainfall, had three gauges made, precisely similar in all respects, and placed one of these gauges on the ground near his house in Westminster, another on the roof of that house, and the third on the top of the centre tower of Westminster Abbey. He did not remember the exact figures, but, roughly speaking, the gauge on the ground registered some twenty-five inches, that on the roof of his house eighteen inches, and that on top of the Abbey about twelve inches. The experiment had also been tried at York. One gauge was put in the garden of the Museum, the second on the roof (which was about forty feet above the ground), and one on the top of the centre tower of York Minster, and the same relative results were obtained. There were something like six or seven inches in the gauge on the top of the Minster, fifteen inches in that on the top of the Museum, and twenty-one inches in the garden gauge. The same thing had been tried by him with gauges on the tops of poles; but, no matter where tried, the results were identical.

He believed that, in the case suggested by Mr. YEOMAN, it would be found that there would be a deficiency in the upper acre of surface, but by no means so large a deficiency, relatively, as between two eight-inch gauges similarly situated. There was a building at Leeds (the spinning-room of Messrs. MARSHALL & Co.) which covered rather over an acre of ground. It was one of the largest single rooms in the world. The roof was about thirty-five feet high, and was supported by ranges of columns. It was covered with compo, with a grass plot growing over it, and was lighted by little sky-lights. Here was a building one acre or thereabouts in extent. He had a rain-gauge on the roof of that building, and if the gauge, as was the fact, recorded nearly, but not quite, the same amount as the gauge on the

ground in the vicinity, it would be tantamount to this, that the smaller the building, as a rule, the greater would be the intensity (if he might so express it) of the difference between the quantity collected by a gauge on the ground and one on the roof. Without going into the question of the causes, he might say that, in comparing the various quantities at high levels and on the ground with the velocity of wind during the time of fall, a close agreement was found, and it seemed to him extremely probable that the main cause of the difference was simply that the rain was driven at a greater angle,—the friction of the air was less than on the surface, therefore, the wind was stronger,—and the area presented by the gauge being less, a less amount was obtained. At the same time there was the condensation theory which had something in it.

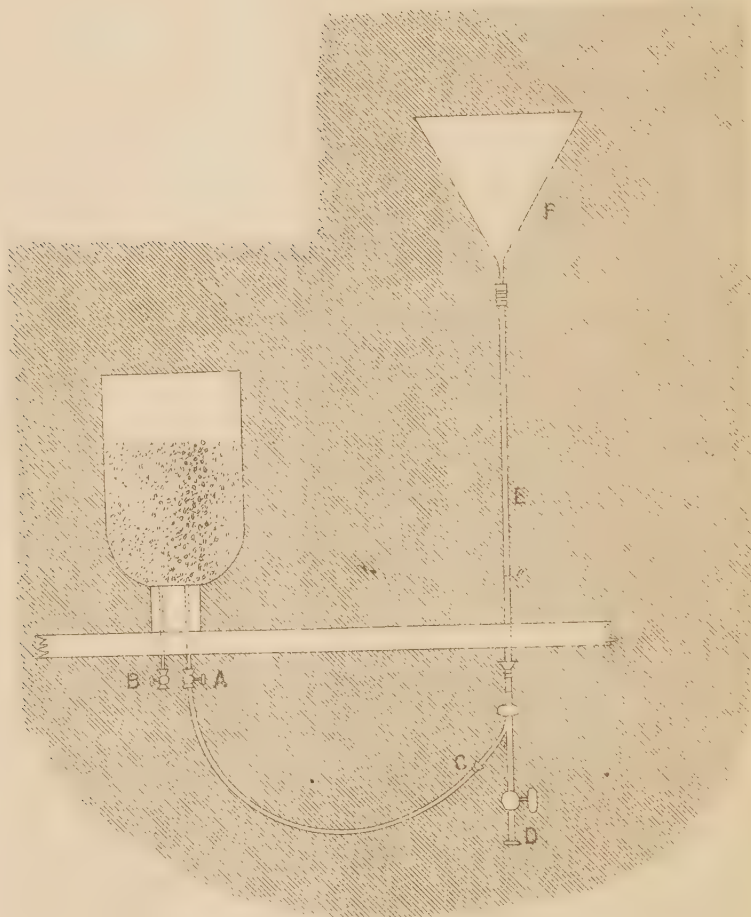
Some facts were given by Mr. CLUTTERBUCK relative to the discharge from tiles as compared with slates. He (Mr. SYMONS) was very glad to hear them, for he did not know of any facts or cases of actual measurements, except that the late Mr. BLAND, of Sittingbourne, had made some attempts of the kind, but he had never seen the results. With regard to a survey of water-bearing strata, he agreed with Mr. CLUTTERBUCK. Referring to Parliamentary action in water questions at the present time, he could not help thinking that there was too much scramble and not enough scientific knowledge. As to Mr. GRANTHAM's complaint that averages were less useful than extremes, he might remark that the results of the calculations and investigations which he (Mr. SYMONS) had made on this subject, led him to believe that the wisest thing was to try first of all to get the averages and from them to compute the extremes. That appeared to be one of the principal objects of high class rainfall work. It was not an easy thing to do by any means; but he did trust that, as rainfall work went on,

it would be found that the extremes were computable from the means, and that was the reason why he had devoted much attention to getting the means, and ascertaining what proportion existed between those means and the extremes.

He was very sorry he did not put into his pocket a letter which he had received, only a few days ago, from Mr. BRAVENDER, of Cirencester, who wrote to him asking him if he would turn his attention to the frequency of summer droughts, and stating that the farmers in his district were complaining very bitterly that the summers were not so liberal of rain as they used to be. The general tenor of that letter fell in with his own idea—based on facts reported to him from different parts of the country—that in some districts tenants, ignorant of the scientific considerations involved, put down drains in dry districts, without regard to the rainfall, and without duly considering the slope of the ground and its geological conditions. He believed that it was owing to the want of such foresight that water had been sold, in the neighbourhood of Boston and other districts, for fourpence or fivepence a pail—a fact of serious significance. He did not think that the records of 100 or 200 years afforded any proof that the rainfall was less now than formerly.

The vote of thanks having been put and carried unanimously, the Meeting then adjourned.

APPARATUS FOR MEASURING THE ABSORBENT AND RETENTIVE POWER OF SAND AND GRAVEL



CAUCES OF GRAVEL USED IN ABOVE APPARATUS



HYDROGEOLOGY :

ONE OF THE DEVELOPMENTS OF

MODERN PRACTICAL GEOLOGY.

BY JOSEPH LUCAS, F.G.S.,

*Read at the Ordinary General Meeting of the INSTITUTION OF SURVEYORS
February 26th, 1877.*

THE PRESIDENT IN THE CHAIR.

AFTER the lapse of nearly a century since the foundations of physical geology were laid by a surveyor, it may not be inappropriate to bring before the Institution of Surveyors an account of the principles and the province of hydrogeology, one of its most recent developments.

The various subjects of modern practical geology admit of the following natural classification :—

1. Physical geology ; which treats of the *positions* of accessible formations, and includes as subdivisions—

(a) Mineralogy ; or, the study of the component parts of the rocks constituting those formations.

(b) Palæontology ; or, the description of the organic remains found in them.

2. Agricultural geology ; which deals with the results of the decomposition of the same rocks after they have been exposed to meteorological influences.

3. Hydrogeology ; the subject of the present memoir.

4. Sanitary geology.

Hydrogeology takes up the history of rain water from the time that it touches the soil, and follows it through the various rocks which it subsequently percolates.

The moment a drop of rain touches the ground, its tendency is to wash the soil down to lower surface levels. The direction in which these particles of the soil move is with the flowing water. This process of mechanical degradation takes place on every slope, until the lessened inclination of the surface retards its downward progress, when it spreads out as a talus, or until it meets with some artificial obstruction, behind which it accumulates as a terrace. Below the face of the chalk escarpment at Boxhill, in Surrey, the rain drift has spread a talus of grey marl and chalk *débris* over the upper green-sand and the gault, and it is a matter of familiar observation that hedges planted along the contours on a hill side, by obstructing its descent, induce an accumulation of rain-drifted soil on their upper side, which appears as a terrace when they come to be removed. The practice of ploughing *up and down* contributes to the descent of the soil, and that of ploughing along the contours tends to hold it up, a consideration that is of value where the soil is thin.

In the Yorkshire dales as many as ten or twelve obsolete road tracks, starting from the same point, and ascending a steep hill side, may commonly be seen. The steepest is the modern one in use, the others having been successively abandoned. In these cases, the removal of the turf by traffic has exposed the soil, when dried by the summer sun, to the scour of the July rains, which sometimes in a single storm have washed down the fine sediment, and spread it as a talus at the foot of the steep ascent, leaving the track choked with an impassable barrier of stones and boulders. As the roads were thus often, through time, deepened several feet, it became necessary, on their abandonment, to

take a steeper course. In this way have originated many of the roads on the oolites of the Cleveland Hills and the millstone grit of the Pennine Chain, which are among the steepest and worst in England.

Steepness has often been communicated to roads through the necessity of mounting up to avoid wet spots, over which the engineering science of the day had no control. These permanent bogs were maintained by springs, and are now mostly drained. The old roads ran from spring to spring, and, as a matter of fact, a skeleton map, showing the roads and settlements in this country previous to the development of the great national industries—especially the cotton, wool, and iron trades—will also show the springs.

The next subject of inquiry is the proportion of the rainfall, or the actual quantity of rain that passes through the soil. This quantity depends upon the percentage of the water it can absorb, which a soil is capable of retaining by capillarity. The more nearly the retentive approximates to the absorbent power, the greater will be the proportion thrown off as flood, and the less will pass through to the springs. I have found in one extreme case, that fine sand, 91 per cent. of whose grains were under $\cdot 03$ inch calibre, retained by capillarity 99 per cent. of the water it absorbed, and that only 1 per cent. drained out at once. When, however, this 1 per cent. was rapidly poured on to the sand again, it caused a larger quantity to drain through. Each amount so poured back out of four repetitions, caused a successive increase in the amount draining out, after which no further increase took place. (Table 2, No. 2.) From this I infer that a larger percentage will pass through from a violent shower than from a more gentle one, the quantity falling being the same; and, further, that a violent shower falling on a soil previously saturated, will carry through, not only its own proportion, but part of that retained from the previous

shower. Numerous instances occur in Mr. EVANS's percolation tables, in which the quantity recorded as absorbed exceeds the rain, both for the day, month, and year. These appear to be explained by the above experiment.

The coarsest sandy soils will retain about 30 per cent. of the water they can absorb, and, in nature, soils range from such extreme coarseness to capillary clays, which are classed as impervious.

These clays become charged with water up to a certain point, when they burst, at some point where the tension is greatest, or where, from the form of the ground, the support from the surrounding soil is least, and a surface slip takes place. These slips result from want of proper drainage of the soil, which tends to move in the direction of the flowing water. When this water cannot gain access to the interior, it naturally escapes outwards, and flows down towards the lowest surface level, carrying the soil with it. In clay cuttings, which are nothing but artificial valleys whose sides stand at an unnatural angle, the lowest surface level is the bottom of the cutting; consequently, the water absorbed by the sides drains towards that level, carrying the soil with it whenever the maximum tension is reached. Following nature, who gives us an example in the case of alternate beds of sandstone and shale, these clay banks should be drained internally to a lower level than the bottom of the cutting, so as to give the soil the tendency to move inwards towards the drain, which, in imitation of nature, should consist of a dry wall of blocks of stone or slag. It was long ago pointed out by the Rev. J. C. CLUTTERBUCK that the practice of cutting a trench along the top of the bank, has the effect of letting the water in, and thus causing the mischief.

Rain falling on the soils that are the result of the decomposition of these clays, generates a class of shallow springs included under the name "land springs," a term which should

be confined to waters contained in or issuing from such soils or from superficial deposits of sand, gravel, or clay, or other deposits which constitute the superficial geology—in opposition to “main springs,” which should be held to mean water contained in or issuing from all rocks constituting the solid geology. Land springs are chiefly of interest to the agriculturist, and main springs to the engineer; but by no means exclusively so in either case, for many gathering grounds on the Pennine Chain depend for no inconsiderable portion of their supply upon land springs, and, as will appear in the sequel, many, if not most, of our successful ponds depend upon main springs. Many villages still depend wholly upon land springs, which formerly supplied the Metropolis itself.

The next object of the hydrogeologist is to ascertain what becomes of the water that penetrates the soil. The soil is dried by the summer heat. On its saturation by the first two or three inches of the autumn rains, the fact is first manifested in the percolators. The succeeding rains cannot farther charge the soil, therefore all the water in excess of that required to keep the soil saturated, runs off the clays and sinks in the sands and limestones. Thus the effects, first felt in the percolators or the soil, are almost immediately seen in the rivers, and, after a time, in the wells. Mr. EVANS's percolator at Nash Mills began to show absorption after a long drought at the end of October 1872, which increased in November, so that the Thames began to be in a state of flood that lasted nearly five months. The day of maximum absorption at Nash Mills was December 17th, 1872, and the day of maximum flood in the Thames was December 23rd, or on the sixth day. Mr. CLUTTERBUCK's well, at Long Wittenham Vicarage, in gravel on gault clay, reached its maximum on or about the 7th of January, or about the 21st day after the great absorption, and the fifteenth after the maximum flood in the Thames. The chalk wells

followed a little later. They had passed their maximum before the 28th of the month. The springs at Carshalton were in greatest volume in January, when they flooded the roads and fields.

In tracing the course of water absorbed from the surface of infiltration to the various points of efflux, the hydrogeologist has to define the form and position of the resultant water-system. The water-system is that part of a permeable bed in which the downward flow of rain-water thus absorbed has been so far arrested as to charge fully the pores and fissures communicating with the surface of infiltration. Except in the case of outliers and surface deposits of porous strata, every water system is ultimately contained between impervious barriers. The relative heights of these barriers determine the direction of flow of the percolating water, which, irrespective of geological position, is from the higher and over the lower. This rule is subject to rare exceptions when the contained water attains a greater altitude than either. As a matter of fact, springs from the base of the chalk escarpment, along the tract on which the tertiary base is at a lower level than the chalk marl, are extremely rare; whereas, the important series of springs flowing over the London clay to the Thames, each issuing from the chalk as a ready-formed river, is notorious. The upper green-sand, on the other hand, is characterized by its springs, and here the chalk marl ranges at a higher level than the gault over which they flow.

The inequalities in altitude along the lines of both barriers determine the position of the upward surface of the water system under the exposed areas of the containing rock. The lowest surface levels attained by the barriers on the lines of their junction with the porous bed, viz., the valleys of the transverse rivers, and the points of issue of

the most powerful springs, lie in a plane or system of planes, variously inclined, above which the figure of the water surface, or "water line," irrespective of its variations, is regulated mainly by the capacity for discharge of the contained fissures.

The greater capacity of the larger fissures requiring less head to discharge equal supplies by rain absorbed, induces a depression in the surface of the water system below. The flow is from both sides towards, and then down, the axis of this trough, which, when enlarged by external causes, attains gigantic size in the case of the valleys of transverse rivers. The principal ramifications of the vertical fissures constitute lines of weakness, marked by the dry valley systems that characterize the outcropping surfaces of all porous strata, which lines have been adopted and enlarged as channels rather than formed by the percolating water.

In sandstones and limestones, and in all rocks that have attained a high degree of consolidation, man is dependent upon the free water in the fissures, and, the greater the degree of consolidation, the more does the question of available water become one of fissures. In loose uncemented sands there are no fissures, and the pores are capable of discharging large quantities of water. As consolidation proceeds, the accompanying contraction diminishes the size of the pores and generates fissures, many of which are purely internal, and have no outlet in any direction. It is a matter of familiar experience that dry fissures are met with even at lower levels than water-bearing ones traversed in the same well, and in the same water system. As the barrier walls of these dry fissures are often very thin, and are in contact with those that are water-bearing, it follows that no flow of water takes place through the body of the containing rock, for, if there were any such flow, the dry fissures would not be dry. Different parts of

the same bed will vary considerably in respect of its porosity. Little value attaches to experiments made with a single hand specimen. It sometimes happens that dry fissures cut in a well drain off water struck at a higher point in the same well, and in the same water system, and that this drainage ceases when the dry fissures become filled. This was the case in the well sunk in the chalk at Halstead station in Kent, in which, after running down a hole for a few days, the water regained its natural level. It would appear that in such cases a system of internal fissures with no outlet is cut by the well.

There are cases on record in which water flowing into a well all in one water system has been carried off by fissures struck lower down, and has been permanently lost. At high levels, as in the chalk hills, this may easily occur; but at low levels it is hard to understand how such a permanent result can be possible, save in the presence of an out-draught from some neighbouring pumping-station. As regards a well sunk in one water system, the hydrogeologist cannot foretell the occurrence of such dry fissures, but he would be guided by the previously ascertained figure of the water surface in its minimum or lowest position as to the depth to which it would be prudent to carry the well. Where the figure of the water line rises considerably above its general level in the same locality, it does so because over that particular area the fissural capacity for discharge is smaller than it is on the surrounding district, and not because the quantity of water is larger. For example, along the chalk hills on a line parallel to the scarp between Guildford and Dorking, where there is no *primâ facie* reason for any considerable variation in level in the water line, there are two prominent bosses, as it were, which are the relics of the water system at its natural elevation, the water east and west of them having been lowered by the above-named

systems of fissures. In one of these bosses, at Effingham Hill Lodge, there is a well 399 feet deep, which actually passes through the chalk, and derives its water from the malm rock of the upper green-sand. There is a tradition that, in sinking this well, the sinkers passed through water in the chalk. It is probable that this story has foundation in fact, as two wells at Effingham Hill House, which are fed by weak chalk springs, have their water 100 feet nearer the surface, and are under 200 feet deep. The deepening of wells so placed would be attended with the risk of draining off the weak springs, which the owner is fortunate in procuring so near the surface at such an elevation as nearly 600 feet above the sea on the chalk hills.

There are also cases on record of the loss of water in a well from piercing through the barrier which holds it up, so as to cause it to drain into a porous bed below. The conditions in which this takes place are more or less local. In the presence of exhaustion by pumping in the lower stratum it may occur anywhere; otherwise it can only take place where the water line in the lower stratum is at a lower level than the bottom of the barrier of clay or shale pierced in the well—as under the spurs of the tertiaries partially ascending the chalk hills, and similar tracts of millstone grit country reposing on carboniferous limestone, and, in fact, in any position in which the above condition is fulfilled.

The figure of the water line, as determined by well measurements, irrespective of the geological position, slopes from the higher to the lower containing barrier, over which it flows as a spring. A spring implies the existence of water at a higher level in the rock from which it flows.

The prime indicator of the presence of subterranean water is a spring. The existence of a spring has determined the site of innumerable settlements, many of which have long outstripped the capabilities of the fountain to

supply their wants. When this result was first attained in the history of each little colony, recourse was had to the primitive expedient of hollowing out a cavity in the ground to gain by dipping the water that had ceased to flow above the surface. In our own island we have ocular demonstration of the practice. All our successful ponds, except such as have originated as quarries and gravel pits, and many lakes and ornamental waters of larger pretensions, owe their origin to the existence of the springs which still feed them; and have assumed their present shape by reiterated processes of excavation, supplemented in many cases by the erection of dams and embankments. As a matter of fact, in the inhabited parts of this island, and to a great extent also in the mountain districts, there are very few springs—from the merest damp spot on the ground that has been the forerunner of a pond, to the ready formed river—that have not been made the subject of some artificial contrivances designed to maintain their permanence, and to compensate in some degree for their seasonal fluctuations in volume. Ponds, as we know them, are characteristic of the soft soil of our island. In rocky countries where stone is plentiful, and the art of working it was early known, there still exist some very ancient tanks, which with us have only come into at all general use in comparatively modern times. It is probably to the growth of the settlements which formed round springs that the art of well digging was due. The idea was to catch the same spring a little distance off—an idea which forms the basis of our expectations on sinking a well to-day.

The large springs issuing as ready formed rivers are subject to great fluctuations in volume, the maximum being about ten times as great as the minimum. These need not be discussed, but there is a class of weak springs of which the

Well Head at Merstham may be taken as a type, that issue from sands, and are characterized by excavated ponds. The streams they generate when supplemented by dams, are of sufficient importance to be called into requisition for industrial service, and a large number of our older mills owe their motive power to such trivial sources. The value of these springs depends on their permanence and not on their volume, which is, in fact, small. They are eminently characteristic of the upper green-sand, and of all porous beds similarly placed in respect of physical features. Beds of sandstone and limestone alternating with shales and cropping out in a hill side are marked by numerous perennial springs issuing from their base. When the outcrop of a porous bed is accompanied by high ground at the back, the principal part of the rain absorbed will re-issue from its base, a small part descending with the dip. Where there is low ground at the back, the principal issue will be from springs at the base of the superincumbent impervious barrier. Of the first class are the Well Head, Merstham, from the upper green-sand, and the Farnham Bourne Mill Stream from the chalk; of the second class are the chalk springs thrown out by the tertiaries, at Carshalton and elsewhere. There is another class of weak springs which characterizes the outcrop of thin beds of sand on what is known as "flat country." They ooze rather than flow, and are seldom in sufficient volume to generate a brook. They have well served the purpose of the districts in which they are found, and have not been without their effect in determining the distribution of pasturing country, inasmuch as they afford a ready means of obtaining a cheap supply of water available for cattle. For this reason few, if any, have been neglected, but, on the contrary, the outcrop of the sand bed is marked by a chain of ponds, each of which has been formed by reiterated

excavations of the parent source. Without these annual "cleanings out" the site of the ponds would soon be marked only by boggy ground.

Lenticular beds of sand, having no great horizontal range, are common in many formations of clay, but even where these are absent, successful ponds are frequently possible, owing to the tardy drainage of the soil that results from the general assumption of flatness distinguishing these formations. Such ponds are, or have been, dug for the purpose of draining spots upon which storm-waters would naturally collect. These spots, though locally at low levels, may lie far above the flood-lines of the district. Certain shallow valleys which present an intermediate phase are, in Surrey, known as "moors." They are either boggy, or sparsely overgrown with birch, alders, and willows; and in many cases—as at the New Pond east of Merstham—have been converted into large ponds. The New Pond rests partly upon gault and partly upon the grey beds of the upper green-sand, and is therefore probably spring fed. It does not cover more than one-sixth part of the moor in which it lies, which could therefore contain five other similar ponds. I cannot doubt that this is one of a series of noble examples, for which Surrey is remarkable, of the converting into ponds, in preference to draining, of sites that were formerly in marsh. Such are the Frensham and Abbots Ponds on the lower green-sand, the Fleet, and what was formerly known as Gracious Pond (but which has ceased to exist), on the Bagshots, and probably Virginia Water, all of which must from their positions be fed by main springs. Except the last, these ponds were all of monastic origin, and were formed to furnish the religious houses of Farnham and Chertsey with an article of diet prescribed by their church. The names of Abbots and Gracious betray this origin. On being

laid dry in 1810, Gracious Pond exhibited the original peat on the north side.

Numerous ponds and ornamental waters are maintained by land springs. Of such kind are the ponds at high elevations on the Chalk Downs, which are remarkable for the persistency with which they defy evaporation. A careful survey of a very large number of these ponds, on the North Downs of Kent and Surrey, has convinced me that they are formed in, and maintained in water by, a superficial covering of sand or sandy clay which is to all appearance the argillaceous base of the Thanet sand, or, where that is absent, of the Woolwich and Reading beds, left adhering to the chalk. This argillaceous sand may be plainly seen in and around the successful ponds, which often have old names, whereas there are numerous instances of puddled ponds on bare chalk both on the North and South Downs, which are dry for months together. From a large experience of these facts, I venture to record my disbelief in the existence of the so-called dew ponds on the highest ridges of the Chalk Downs, which are supposed to be maintained in a perennial supply of water by the sole agency of condensation.

A conspicuous instance of a large pond on a ridge is that in the village of Buckland, in Surrey. The gault clay occupies the summit of a ridge, and in it the pond is formed. Close to the pond there is a deep well that goes to the Folkestone sands. This is one of many instances along the same line.

It thus appears that ponds are of three kinds—those that are maintained by main springs; those that are maintained by land springs; and those which are mere drains; and that possibly there may be a fourth kind maintained by condensation. In this last, however, I do not believe.

The surface water taken up by the soil which results from the decomposition of many clays, will maintain ponds in water long after many depending on main springs have run dry, and the reason is that the soil in question is an argillaceous sandy marl, or a sandy clay to the depth of three or four feet, resting on the undecomposed clay below. It will retain by capillarity a large proportion of the water that it absorbs, and this capillarity yields to gravitation very slowly; so that it takes a long time to deliver the same amount that it absorbs quickly. More open sands and gravels retain by capillarity a far smaller proportion of the water they can take up, consequently the water flows more quickly down to replace the abstraction by out-draught or evaporation, and the available reservoir to the pond is more quickly exhausted. A few practical experiments on the absorbent and retentive power of sands of various degrees of fineness have dispelled the astonishment formerly entertained by myself in common with others at the permanence of insignificant surface ponds.

A very large proportion of the cultivated land in England is artificially drained. The quick relief afforded to the soil, and the rapid delivery to the floods effected by this means, in the absence of any counter provisions for the storage of the quantity of water thus prematurely sent down, tends *pro tanto* to increase their volume. This throws upon the cultivated land the onus of contributing unduly to an evil, which, if it cannot be wholly avoided, should not certainly be augmented by artificial means. Concerning the momentous question of floods, I do not touch the engineering or the hydrogeological question further than to indicate the responsibility assumed by the land drainer, in altering hydrogeological conditions.

In reference to this part of the subject I am led to conclude generally:

1. That the primitive pond is a simple excavation of a wet spot.

2. That most of the trivial spots susceptible of being converted into ponds by mere excavation have been so converted.

3. That the country abounds in similar places, on a larger scale, which constitute natural sites for the construction of ponds and reservoirs, at various heights above the flood lines.

This memoir will suitably conclude with an account of the upper green-sand, which is conspicuous for the number and permanence of its springs. Having made a careful survey of the hydrogeology of the upper green-sand between the Hampshire boundary, near Farnham, and the Darent, in Kent, I conclude that, as a water system, it is quite distinct from that of the chalk.

The upper green-sand of hydrogeology is bounded upwards on this area by a bed of marl which is known as the chloritic marl from the presence of numerous green grains, but which in other respects resembles the chalk marl above, into which it passes. It may be some 10 or 12 feet thick, and is not waterbearing.

There is a marked difference between the absence of standing water on the crumbling soil of the upper green-sand and the glistening surface of the chalk marl after rain.

Immediately below this there is a bed of calcareous sandstone, which at both extremities of the area so exceedingly resembles the lower beds of the grey chalk that it bears the distinctive name of the "malm rock," *i.e.*, sand rock. West of Farnham it is thickest, and is of local importance as a water-bearing bed. It gradually thins eastward, but maintains or rather increases its calcareous character as far as Dorking, where it dies out. A little east of Dorking two or three sandstone-bands, which to the west

have underlain the malm rock, unite and form the freestone, which is a "soft, light-coloured, calcareous, green sandstone," to use the excellent description of Professor Prestwich. The freestone maintains its character as far east as Tandridge Hill, about which place the calcareous element reappears and the malm rock occupies the position to the east of the Darent, being at the springs at Newbarns and at St. Edith's Well, Kemsing, which spring from it, in hand specimens undistinguishable by outward appearance from the lower chalk. This bed and the chalk marl above are well seen in the railway cutting near Broughton House.

The malm rock and freestone mostly form a terrace, which is chiefly under the plough. The terrace in question absorbs its own rain and the not inconsiderable quantity that runs down the face of the chalk escarpment in wet weather. The thickness of this bed varies from 10 feet or so to about 30 feet. The rain absorbed by it is partly thrown out as springs by the next bed in descending order, which is a light grey clay or marl about 50 feet thick, sometimes containing bands of sandstone. In a recently cut section above the waterline at Rocks Shaws, near Merstham, this marl is seen to be traversed by numerous vertical fissures, through which water may freely pass. This bed, or these beds, have been variously classed with the upper green-sand and the gault, and are now ranked, palæontologically, as part of the latter. Hydrogeologically, however, they belong to the upper green-sand, part of whose waters flow from their base, being thrown out by the dark blue black clay of the gault below. About half as many springs again flow from this horizon as from the base of the malm rock above, from which it is inferred that the grey beds are not uniformly impervious. Near Kemsing the springs flow from a bed of hard sandstone about a foot thick.

Thus, while the terrace and the principal absorbing surface is formed by the malm rock and firestone, the largest issue indicated, both by the number and strength of the springs, is from the base of the grey beds below. Many of these springs are of considerable note and bear old names.

There are 54 springs from the upper green-sand between the Hampshire boundary on the west, and the village of Kemsing on the east. Of this number, 31 have determined the sites of settlements, of which 24 remain in their original form as farmhouses, and 7 have grown into villages; 6 at least, are enclosed in parks or ornamental grounds; 3 form the sole supply to as many mill-ponds; and 20 remain in their natural condition.

Although there is some doubt as to whether the water of the St. Thomas à Beckett's Well and the Moat Farm Springs at Otford does not come out of the chalk, it may be stated that the evidence of the complete isolation of the upper green-sand water system from that of the chalk on this area is found in the facts—

1st. That west of Farnham, where the tertiaries rise high above the chalk, there is a valley across the chalk, down which the drainage of the tertiary hills flows in wet weather. This water flows on chalk until it reaches the outcrop of the chalk marl, when it sinks into the malm rock, falling 38 feet underground, as seen by a well a few yards distant.

2nd. That east of Farnham powerful springs, feeding the Bourne Mill stream, break out at the chalk marl.

3rd. That the Sherbourn Ponds at Albury are the impounded waters of a chalk spring flowing over the chalk marl.

4th. That at Brockham Lime Works a spring breaks out from the chalk over the chalk marl at 300 feet, while in a well a few yards distant, sunk through the chalk marl, the

water on October 19th, 1876, stood 88 feet from the surface, the well being 95 feet deep, and on February 15th, 1877, stood at 59 feet from the surface, a stream of water pouring into it at points between 30 and 40 feet.

5th. That south of Marden Park the water in a well in the upper green-sand stands 215 feet higher than that in a chalk well one mile and a half distant.

6th. The large number of wells that traverse the chalk marl before reaching water.

7th. The fact that the chalk marl itself is repeatedly seen along the line in question, and that while certain springs can be seen to issue above it, numerous others can be equally proved to issue from points geologically below it.

The large number of unsuccessful undertakings, among wells for water supply and ponds of various scales, justifies the asseveration that hydrogeology as a science has not been duly considered.

APPENDIX.

EXPERIMENTS UPON THE ABSORBENT AND RETENTIVE POWER OF SAND AND GRAVEL.

The first and simplest form of apparatus used in these experiments was a glass funnel, provided with a tap.

A measured and weighed quantity of dried sand was first put into the funnel, and a weighed quantity of water was then added from above, until the levelled upper surface of the sand was just equalled by the water.

The tap was then turned on, and the quantity running out was weighed and subtracted from the quantity put in.

This gave the *quantity absorbed*, and the *quantity draining out at once*.

Only one or two experiments were made with this apparatus, for which was substituted a bell glass, having a diameter of 4 inches at top, and a depth of 6 inches—the shape being cylindrical for 4 inches down. At 6 inches from the top there was a neck, having a diameter of $1\frac{1}{2}$ inches and a depth of $1\frac{1}{4}$.

Into this neck I introduced, by means of a cork, two plain soda-water taps, one, A, for the purpose of introducing water into the sand to be experimented upon, the other, B, to draw off the water which would drain out at once.

On to the tap A was fastened an India-rubber tube of about 2 feet in length, of which the other end was connected with one of two arms of a brass tube, C, the other being provided with a tap, D.

After the junction of these two arms, the single pipe was connected upwards with a vertical glass tube, E, which supports at its summit a glass funnel, F. The funnel was arranged at a higher level than the bell glass containing the sand, and the vertical glass tube was taken a foot in length, so as to extend above and below the bell glass.

A narrow strip of white paper was then stuck on to the glass tube.

When the apparatus was erected, as in the figure, so that the same cross bar supported the bell glass and the glass tube, the mode of using it was as follows:—

The first step was to close the tap D, and open the taps A and B.

Water was then poured through the funnel F until a little flowed out through B, when B was closed, and the bottom of the bell glass dried with a cloth.

The water then stood at the level of the top of the neck of the bell glass.

A cut with a knife was then made on the paper attached to the glass tube, E, at the top of the water in the tube, E.

The tap, A, was then closed: all taps being shut.

A measured and weighed quantity of dried sand was then put into the bell glass and levelled, and a weighed quantity of water, in one or more instalments, was poured into the funnel, F.

The tap, A, was then opened, and the water rose in the sand, driving the air before it, until the sand was filled, when the tap, A, was shut.

The tap, D, was then opened, and the water in the tube E lowered until it reached the mark *e*, when D was shut.

The quantity drawn from the tube E was then weighed and subtracted from the quantity put into the funnel F.

That gave the *quantity absorbed* by the sand.

The tap B was next opened, and the *quantity draining out at once* was weighed.

That, subtracted from the quantity absorbed, gave the *quantity retained by capillarity*.

The materials taken for experiment were clean blown sand from the sea-shore, and fine washed gravel taken up at low tide.

The strainers at my command were severally of the gauge $\cdot 180$, $\cdot 070$, $\cdot 035$, and $\cdot 030$ inch, the holes being circular.

Of the material coming under the denomination blown sand, 91 per cent. consisted of grains of less calibre than $\cdot 030$ inch, and only 2 per cent. ranged above $\cdot 070$ inch.

Of fine gravel, 4 per cent. ranged above $\cdot 180$, 28 per cent. between $\cdot 070$ and $\cdot 18$, and 68 per cent. below $\cdot 070$.

TABLE I.
SAND AND GRAVEL.—PROPORTIONAL ANALYSIS OF ONE IMPERIAL PINT.

PARTS IN ONE IMPERIAL PINT.			WEIGHT OF WATER.		Per Cent. of Water Absorbed.	Retained.	Per Cent. of Water Absorbed.
Gauge.	Weight.	Percentage.	Absorbed.	Draining out at once.			
Inch.	Grains.		Grains.	Grains.		Grains.	
Fine Gravel from the Sea-shore {	More than .180	4.2	150.0	114.0	76.0	36.0	24.0
	.070 to .180	28.3	1,278.0	861.0	67.5	417.0	32.5
	.035 to .070	39.8	1,632.0	1,095.0	67.0	537.0	33.0
	Less than .035	27.7	981.0	94.0	9.6	887.0	90.0
	14,074.9						
Blown Sand from the Sea-shore {	More than .07	0.2	13.9	—	—	—	—
	.035 to .07	4.4	169.0	9.5	5.5	160.0	94.5
	.03 to .035	4.2	128.0	—	—	—	—
	Less than .03	91.2	2,625.0	—	—	—	—
	13,155.3						

SIMILAR EXPERIMENTS UPON ONE PINT OF EACH GAUGE.

Fine Gravel {	.07 to .180	16,080	100.0	3,555.0	2,406.0	67.6	1,148.0	32.4
	.035 to .07	13,610	100.0	3,975.0	2,815.0	70.8	1,160.0	19.2
	Less than .035	14,211	100.0	3,706.0	1,369.0	36.9	2,337.0	65.0

TABLE II.
EXPERIMENTS UPON THE ABSORBENT AND RETENTIVE POWER OF SAND AND GRAVEL.

A Cylinder of 6.75 inches diameter, 8.25 inches deep, and 205.4 cubic inches capacity, was filled with Blown Sand, Of whose grains 91.2 per cent. were less than .030 inch calibre.

4.2	"	"	between	.030 inches and .035 inches.
4.4	"	"	"	.035 " " 0.70 "
.2	"	"	over	.070 "

The following results were obtained (No. 1) :—

No. 1.				
Weight of Water absorbed.	Weight draining out at once.	Weight retained by Capillarity.	Per Cent. flowing out at once.	Per Cent. retained.
29,595.4 gr.	307.8 gr.	29,287 gr.	1	99

The Cylinder was then left for a fortnight, at the end of which time the tap was again turned on, and there was no further flow.

The Cylinder being again filled with water as before, there resulted as follows (No. 2) :—

No. 2.				
Weight absorbed.	Weight draining out at once.	Weight after pouring back the 448 gr.	Weight after pouring back the 458 gr.	Weight after pouring back the 475 gr.
Not measured.	448 grains.	458 grains.	464 grains.	487 grains.
				29,108 grains.

The same experiments were then continued at equal intervals of 8 minutes with similar results.
No sand or visible sediment was brought away in any case. The water was in all cases clear.

TABLE III.

SPRINGS FROM THE UPPER GREEN-SAND.

From Malm Rock and Firestone.	From the Grey Beds.	Approximate Altitude above O. D.	Remarks.
		Feet.	
<i>Farnham Parish—</i>			
Dippenhall		300	Mill Pond below.
Bourne Mill Stream (?) ..			
<i>Seale Parish—</i>			
Seale Quarry			
Cricket's Hill			
Wood east of ditto			
On Parish Boundary			
<i>Puttenham Parish—</i>			
	Ponds		Ponds.
<i>Compton Parish—</i>			
	Field east of Down Farm	275	Pond.
	Do. west of Conduit Farm	270	Pond.
<i>St. Martha's Parish—</i>			
	Tyting Farm	305	Pond.
<i>Dorking Parish—</i>			
	Coombe Farm	290	Ponds.
	Landbarn Farm	275	
<i>Betchworth Parish—</i>			
	Pudding Hole	160	Spring Well.
	Broome Park	245	
<i>Buckland Parish—</i>			
	Rectory		Ponds.
	Kemp's Farm		Pond.
	Hill Farm		Pond.
<i>Reigate Parish—</i>			
	Colley Copse		
	Underhill Park		
	Stone House		
	Dennis Grove		
	East of Green Lane		
<i>Gatton Parish—</i>			
	The Serpentine		Ornamental Waters.
	Fish Pond		
<i>Merstham Parish—</i>			
Well Head		330	{ Pond at and Mill Pond below.
<i>Chaldon Parish—</i>			
	Picket's Wood	365	"New Pond" below.
	Furze-field Wood, on bound- ary	375	
Quarry Farm		415	

TABLE III.—SPRINGS FROM THE UPPER GREEN-SAND—(continued).

From Malm Rock and Firestone.	From the Grey Beds.	Approximate Altitude above O. D.	Remarks.
		Feet.	
<i>Blechingley Parish—</i>			
Conduit Well			Spring Well.
Whitehill Farm			
North-east of North Park } Cottage	West of North Park Cottage		
<i>Godstone Parish—</i>			
	North of Godstone Corner } Wood		
Flinthall Farm (A, B, C) .	Quarry Farm	490	Pond.
<i>Oxted Parish—</i>			
	Rye Wood	450	
<i>Titsey Parish—</i>			
	A } near Limpsfield Lodge } B } Farm	420	Pond.
Titsey Park, near House.		440	
	South-East of Pilgrim's } Lodge Farm	460	Pond.
<i>Westerham Parish—</i>			
	North of Charman's	395	Pond below.
<i>Brasted Parish—</i>			
	West of Court Lodge	390	Mill Pond below.
<i>Chevening Parish—</i>			
	Chevening	335	Ornamental Water.
	Morant's Court	295	Ponds.
<i>Otford Parish—</i>			
(WEST OF DARENT)—			
Broughton House		270	Pond below.
Newbarns		250	Ponds.
	Rye House	260	
(EAST OF DARENT)—			
Moat Farm (?)		240	Pond.
St. Thomas à Beckett's (?)		240	Walled Pond.
<i>Kemsing Parish—</i>			
	One-third mile West of } Dipper's Hall	290	
St. Edith's Well	South of Dipper's Hall ..	290	
		304	Spring Well.

TABLE IV.

UPPER GREEN-SAND WELLS IN SURREY.—*Measured by J. LUCAS.*

	Approximate Height of Well-mouth.	Depth of Well.	Date.	To Water.	Waterline above O.D. (approx- imate).	Date.	To Water.	Approximate Waterline.
	ft.	ft. in.	1876	ft. in.	ft. in.	1877	ft. in.	ft. in.
FARNHAM PARISH—								
Dippenhall, through Chalk and Chalk Marl	370	105 0	Dec 1	99 0	270 0			
Corner of Lane (S. of do.) A, Cottage (E. of last) B, into Grey Beds	350	38 0	" "	33 0	320 0			
Cottages N.E. of Brick and tile Factory, through Chalk Marl	340	45 4	" "	37 8	302 0			
Runfold Cottages, in Malm Rock	258	18 6	" 9	7 1	250 0			
DORKING PARISH—								
Coombe Farm, all in Grey Beds		12 0						
Landbarn Farm, do. do.	285	10 0				Jan. 13	0 3	
Lower Chalkpit Cottages..	220	108 5	Sept. 29	96 2	124 0	" Feb. 15	85 4	135 0
Upper do. do. ..	230	116 0	" "	115 4	115 0	Jan. 13	83 2	137 0
Boxhill Farm Cottage, all in Grey Beds	180	22 10				Feb. 15	81 4	149 0
Do. do. Roadside..							82 7	147 0
							20 6	160 0
BETCHWORTH PARISH—								
Brockham Lime Works, through Chalk Marl ...	304	94 11	Oct. 19	87 11	216 1	" "	59 2	244 10
Holmes Farm Cottage, through a little Chalk Marl	320	83 4	" "	81 8	238 0	" "	56 10	263 0
MERSTHAM PARISH—								
Jolliffe Arms, through Chalk and Chalk Marl..	377	100 0	May 25, '75	60 5	316 7			
Jolliffe Row, through Chalk Marl		88 4	Feb. 28, '76	58 4	318 8	Jan. 24	54 9	322 3
Quarry Dean			Dec. 6, '76	82 2	294 10	" "	39 1	
Noddyshall Cottages, in Firestone, dries nearly every summer	410	44 4	" " "	65 4		" "		
						" "	18 0	392 0
CHALDON PARISH—								
Rocks Shaw Quarry Well, all in Firestone	430	56 4				" "	29 4	400 0
Do. Cottage, Grey Beds (?) and Gault	370	13 7				" "	3 5	367 0
Field N. of Furze field Wood		[28 0]						
GODSTONE PARISH—								
Quarry S. of Marden Park, through Firestone	565	66 0	Nov. 11, '74	34 2	531 0			
			Oct. 20, '76	36 2	529 0			
BRASTEAD PARISH—								
Cottages, Hogtrough Hill.	450	62 0	Nov. 16, '74	Dry				
			Oct. 20, '76	Dry				
CHEVENING PARISH—								
Morants Court Farm	352	93 10	Mar. 9	41 5	310 7			
OTFORD PARISH—								
Little Dunton, (?) Chalk Well	295	49 3	" "	34 9	260 3			

MR. R. C. DRIVER (Member) had much pleasure in proposing a vote of thanks to Mr. LUCAS for his very able Paper, which followed with peculiar appropriateness the Paper read by Mr. SYMONS at the last Meeting. It appeared to him that Mr. LUCAS had thrown a considerable amount of new light on this subject. He had evidently that practical acquaintance with it, which was generally entirely wanting in those who pretended to advise as to the presence of underground water, and the depth at which it would be met with, and who frequently landed the owners of estates in heavy expenses, without any beneficial result.

MR. D. WATNEY (Member), who seconded the vote of thanks, said that he had listened to Mr. LUCAS's Paper with great interest. Allusion had been made by the author to the ponds in the upper chalk districts. He might mention that there was an exceedingly simple way of retaining the pond water in those districts, which consisted in wheeling a broad-wheeled cart round and round in the bed of the pond until it was puddled and rendered practically impervious. He had seen ponds formed in this way which retained water throughout several long periods of drought. There was a curious phenomenon to which he would draw the attention of Mr. LUCAS, who had omitted any notice of it, perhaps intentionally, from the Paper—he referred to the spring rising at Marden Park, called the Bourne water, which flowed through the town of Croydon. It was running at the present time, and was well worth a visit. Before the close of the discussion (which, he presumed, would be adjourned) he hoped to be able to furnish some statistics as to the enormous quantity of water now flowing in the Bourne. A peculiarity about this stream was that it rose only about once in six years. It appeared to depend upon the rainfall, rising whenever the fall exceeded the average by two or three inches.

Mr. G. J. SYMONS (Visitor) observed that, as the author had said, Hydrogeology took up the history of rain water from the time that it touched the soil, or, in other words, left his department, where it entered Mr. LUCAS's; consequently, he was not prepared to discuss the Paper at any great length. There were one or two points, however, to which he would, with the permission of the Meeting, briefly allude.

Reference was made by Mr. LUCAS to experiments on percolation carried out by Mr. EVANS. He did not wish to say a word either against the experiments or the gentleman who made them, than whom scarcely any one stood higher in his esteem, but it was only right to mention that the accuracy of those experiments had been impugned by some—whether rightly or wrongly he was not prepared to say—and one should not forget what had been done in this direction by MESSRS. LAWES and GILBERT. The recent experiments of Mr. LAWES were on a far larger scale than those of Mr. EVANS. In the one case, old experiments, started twenty years ago, were being conducted under pretty nearly the same conditions under which they originated, while in the other, entirely new methods were employed, and neither trouble nor expense was spared to secure an accurate result. Without taking up too much time, he would endeavour to give some description of what was being done by the gentlemen to whom he had referred.

In Mr. EVANS' experiments, the old Dalton percolating gauge was used, the earth being rammed into it. Whether or not it truly represented the percolating properties of a corresponding portion of natural soil was doubtful; but it had been stated that the soil had got into a rather puddled condition. MESSRS. LAWES & GILBERT endeavoured to obviate this as far as possible by not *filling* their Dalton gauge (if he could call it a gauge, for it was very large), but

simply cutting a trench round portions of the earth selected for the experiment, and then building up the sides with bricks and mortar to make it watertight. The percolating gauges were 6 feet square, and 3, 6, and 9 feet deep respectively, that is, there were three plots of land undercut, and a carboy was placed under each to receive the percolating water at these depths of 3, 6, or 9 feet, thus giving three separate points of measurement. Another experiment involved an erection of 120 or 140 feet in diameter in the shape of an amphitheatre. Entrance was effected by descending a flight of steps, and all round the interior was a series of doors, each of which led to the bottom of circular vessels, filled with earth, the upper surfaces of which were devoted to all kinds of agricultural purposes, bearing crops of various descriptions. In this way the amount of percolation, according to the cultivation and characteristics of the soil on the top, was accurately measured. There was one noticeable point connected with the filling of these vessels. He observed on the occasion of his visit large piles of earth by the side of the cylinders, and was informed that they were the surplus of the soil excavated, which it had been found impossible to pack into the space from which it was derived, and this in spite of having subjected the contents of the vessels to considerable weights, and to exposure to rain for a lengthened period. He believed it was a fact that the natural condition of soil once disturbed, it was perfectly impossible to pack it again into the same cubical space.

Reference was made by Mr. Lucas to some experiments which he had conducted as to the quantity of water which would run through sand. No doubt Mr. Lucas would give the necessary information as to the size of the apparatus employed, and the arrangements for producing the artificial shower, than which few things were more difficult to produce

with a fair resemblance to nature. The author had very properly said "that little value attached to experiments made with a single hand specimen," and he was inclined to think experiments on percolation were equally unsatisfactory, unless conducted on a large scale, and with apparatus of considerable size.

The rising of the Bourne stream, which had been referred to, was a phenomenon of great interest, and a visit to the locality would well repay any one. He was invited to go down to Croydon by Mr. BALDWIN LATHAM (who had spent a good deal of money in making careful observations), and it was some proof of the satisfactory advance which hydrogeological science was making, that Mr. LATHAM inserted in the Croydon newspapers, before the Bourne broke out, an announcement of the day on which it would occur, and his prediction was fulfilled. The explanation of the rising of the water was, he ventured to think, very simple. It was nothing more than this—that when the stratum of gravel had as much water in it as it could hold, the additional water, not being able to run underground, rose to the surface, and ran over the top of the gravel. This seemed so obvious, that the only extraordinary thing about it was that it had not been found out long ago.

With respect to dew ponds, he would like to ask Mr. WATNEY whether the ponds to which he had referred were originally filled artificially, or wholly by the rainfall. The temperature of the water in these so called dew ponds was very nearly equal to the dew point temperature of the air passing over them, and so long as that was the case there could be neither evaporation nor condensation. The amount of evaporation from the natural surface of the water in this country was not accurately known, but probably did not exceed 20 inches, and when it was recollected that these dew ponds were generally at a height of 300 or 400 feet

above the level of the sea, the temperature of the water could never rise to anything like that of ponds of ornamental water where the experiments were made; and inasmuch as the temperature of the water in the dew ponds was nearly equal to that of the dew point of the air passing over them, there was no evaporation. The dew ponds were naturally fed by the rainfall in those districts, and he was inclined to regard that as the explanation of their remaining full.

Mr. WATNEY said that the ponds he had referred to were not fed by springs. They had simply been made by the side of hard roads, which roads had a fall to them of 200 or 300 yards, and it was the rainfall on those roads which kept the ponds supplied.

Mr. T. SMITH WOOLLEY (Vice-President) could speak from experience of ponds on the Wiltshire Downs which had an unfailing supply of water without aid from springs. Mr. SYMONS' explanation of the probable causes of their permanence seemed to him to be extremely satisfactory

As regarded Mr. LUCAS's Paper he could say that, had he enjoyed the opportunity of reading it some years ago, he would have been saved some inconvenience. At a place in Leicestershire where he had an indifferent supply of water in a well, he sought to increase it by boring, and the result was that he lost all.

He was extremely interested in Mr. LUCAS's speculations as to the causes which had determined the direction of ancient roads. Two things which had puzzled him, and which, perhaps, Mr. LUCAS could explain, were, first, how the Roman roads were supplied with water, seeing that they passed, regardless of ponds or springs of any kind, over immense districts of waterless country; and, secondly, how the ancient fortifications and the so-called "British villages," such

as those on the moorlands of Yorkshire and the Downs of Wiltshire were so supplied. His friend, Mr. DRIVER, had alluded to the ignorant and incompetent persons who professed to advise on the practicability of obtaining underground water. Quite recently in Lincolnshire, a man from Gloucestershire had been going about with a divining-rod, professing to find underground springs, and an exceedingly shrewd acquaintance of his was apparently convinced that this individual possessed the mysterious art. The test his friend put to him was this:—he took him over a place where there was a pipe conveying water from a spring, some distance off, to his house, and when they crossed over the place where the hidden pipe lay, his friend, to his astonishment, saw the rod turn up in the fellow's hand. It was surprising to find an intelligent man who could be convinced of the genuineness of this pretended power, and it was clear that the diviner possessed considerable art of some kind.

Mr. R. B. GRANTHAM (Associate of Council) begged to move the adjournment of the discussion, which involved points of great interest to him personally. He confessed that he had not been able, from a cursory reading of the Paper, to find points sufficiently tangible to discuss without a more attentive perusal, but he hoped at the next Meeting to be in a position to offer some remarks relating to other parts of the kingdom than those specially referred to by Mr. LUCAS. On the next occasion it was probable that several eminent geologists would be present, whose aid was very important in discussing a Paper of this particular character.

Mr. E. RYDE (Vice-President) seconded the motion for adjourning the discussion. He thought Mr. LUCAS had fallen into an error in stating that the mills in Surrey were

most of them on side streams. He was familiar with every mill in Surrey, or nearly so. The two principal rivers in Surrey were the Wey and the Mole, and the chief mills in the county were on one or the other of those streams.

The PRESIDENT concurred in the suggestion that the discussion should be adjourned, when he hoped that some of the country members would contribute the results of their experience, both as to the rainfall, and as to the hydrogeology of the different parts of England.

The discussion was then adjourned to the next Meeting.

AT
THE ORDINARY GENERAL MEETING,

Held on Monday, March 12th, 1877.

THE PRESIDENT IN THE CHAIR.

The discussion on the Paper read by Mr. J. LUCAS at the last Meeting, entitled "Hydrogeology: one of the Developments of Modern Practical Geology," was resumed by

Mr. R. B. GRANTHAM (Associate of Council), who said that he had read the Paper attentively since the last Meeting, and had found in it some points of interest. Many of them, however, were archæological rather than geological; such as the ingenious inferences as to the formation of roads and the selection of sites for settlements. On the other hand, many of the more properly scientific facts were self-evident, and were perfectly familiar to those possessing an elementary knowledge of geology. The Diagram exhibited by Mr. LUCAS had evidently been prepared with great care, and contained many details of interest; but it referred to little more than a single formation, and both the Paper and the Diagram could only be regarded as a small contribution towards a more accurate knowledge of what Mr. LUCAS called, by a new name, the Hydrogeology of the country generally.

His attention had been arrested, on reading the Paper, by a passage on page 166, the meaning of which he had failed to master. The words were: "This throws upon the cultivated land the onus of contriving unduly to an evil

which, if it cannot be wholly avoided, should not certainly be augmented by artificial means." This sentence was rather mysterious, and seemed at once to say something and nothing. If it were meant as a cautious condemnation of that system of subsoil drainage which had proved of such enormous benefit to the country, he could not help expressing his total dissent from Mr. LUCAS's view. The answer to any such contention would clearly be, that it is better to have occasional floods than permanently wet land; and this was quite sufficient to justify the land-drainer, whose business it was to alter those natural hydrogeological conditions which the author warned him to be careful in interfering with.

He did not agree that nature was the best guide as to the hydrogeological wants of the land, because those wants varied with the purposes and objects of those who used the land for the time being. What one looked for in a Paper which professed to deal with Hydrogeology was guidance as to where the most abundant and enduring supplies of water could be found. This was the great service that the science was capable of rendering; and he confessed to a little disappointment that Mr. LUCAS's Paper did not convey more information on the point. The tables at the end of the Paper were evidently prepared with care. They were both useful and interesting, and Mr. LUCAS was entitled to great credit for their preparation.

Turning from the consideration of Mr. LUCAS's Paper, he proposed to offer a few observations upon the water-bearing conditions of the district known as the Cotswold Hills, where the development of the stratification, and the causes leading to the outpour of water, were about as clear and as well defined as could easily be imagined, and were useful in connection with the supply of water to the Thames. The section which he exhibited extended from Marlborough

Downs to the Avon. It would be seen that it commenced with the chalk on the Marlborough Downs, and embraced the forest marble, the greater and lesser oolite, the fuller's earth, Oxford clay, cornbrash, and lias, by the time it reached the Avon, in Gloucestershire. The water came mostly from the fuller's earth. In other places—in the valley of the Stroud Water, for instance,—all these strata had been washed away, and denuded down to the upper lias clay, above which the Mitford Sands yielded a large supply, which poured down that valley. The general lie of the stratification of the Cotswold Hills was south-west and south. Out of these strata rose the Swill Brook, Thames Head, Churn, Coln, Windrush, Evenlode, Cherwell, Ray, and Thame. There was a large escarpment of the oolite opposite Cheltenham,—that town itself lying in a bed of lias. He had examined sixty springs along the face of that escarpment, to see if it were possible to supply the town from that formation; but, as the strata lay in the direction he had indicated, the water naturally followed it through the oolite, over the fuller's earth; and the consequence was that very little was obtained in proportion to their expectations.

He had received from Mr. BRAVENDER his register of rainfall taken for the last eight years, and a section illustrating the hydrogeology of the Boxwell Spring at South Cerney, near Cirencester.* On looking at the geological maps for the same district, it would be observed that there existed there a large fault. This fault threw out the Boxwell Spring, and illustrated in a remarkable manner the effects of such peculiarities in the stratification upon the course of underground water. The line of stratification was suddenly thrown down, and the water ran over the lias, but really came out of the fuller's earth, lying at a considerably lower relative level under the oolite.

* For this section and the accompanying description, see page 208.

He did not desire to be understood as wishing to treat Mr. LUCAS's views with anything but the utmost courtesy, or to discourage any one who was so kind as to read papers to the Institution. He felt that the Institution was much indebted to Mr. LUCAS for the valuable and interesting facts which he had brought under their notice. What he complained of was rather what the author had not said than what he had said, and he had also felt it incumbent on him to point out that the Paper (as the author would probably admit), dealt only with a small section of a very great subject.

PROFESSOR D. T. ANSTED (Visitor) was glad to observe the spread of information upon the important subject of water-supply from the earth, and welcomed any contribution towards a fuller knowledge of the subject. The author of the Paper had, he believed, given a new name to a department of geology with which all were more or less familiar; but he was bound to say, as he had said on a previous occasion, that he did not altogether recognise it as distinguishing one thing in geological matters from another. The time had not yet come when one could look on the geology of the water-bearing strata as dis severed from other departments of geology; and, therefore, in dealing with the subject, he proposed to speak rather of geology than of that particular phase of it to which the author had attached a special name.

Undoubtedly, the most important subject in this department of the science, and the most worthy of special study, was the condition of the water in the chalk; and, if Mr. LUCAS had limited his remarks to that formation, and to the consideration of the valuable materials relating to it which he had collected for the purposes of this Paper, and of the Paper read at the Institution of Civil Engineers, he would have welcomed him as a most useful worker in this

department. He did not, however, agree with his attempts to theorize with reference to rocks generally from facts connected with the water-levels of the chalk, especially with reference to those rocks which were not of the nature of limestone, and belonged either to the sands or to the clays. He supposed that Mr. Lucas would include, for his so-called hydrogeological purposes, the older rocks, the slates, granites, &c., all of which occasionally contained supplies of water, which it was not unfrequently necessary and desirable to get at, if possible. He imagined that the great object of applying the knowledge of geology to the subject of water was to utilize the knowledge of rocks and of the water-formed crust of the earth, to determine where to look for water, and what quantity would, under given circumstances, probably be found.

The great object of obtaining large quantities of water was the supply of towns, and many people considered that if one town could be supplied from a certain formation, any town (even London itself) could be supplied. It was, however, hardly safe, he thought, to generalize in any such way. There were many rocks which would yield a fair supply of water, but they must be studied separately. The subject was one common to geologists, engineers, and surveyors, who might very well unite, and, by the tabulation of observations with reference to the water in the chalk, furnish a great deal of useful information in a very compact form.

The author of the Paper had evidently done his work very carefully, and, as far as he could judge, it was likely to be exceedingly useful. He was also entitled to credit for the way in which he had prepared and presented his facts in a tabular form. But the subject of water in rocks was not to be settled by one series of observations, and he did not agree with Mr. Lucas in thinking that the level of the

water in all rocks—such as the limestone formation or the gritstone formation of the north of England—could be found as it could be in the chalk. He spoke from an experience of some thirty years spent in studying this subject, and in practising it on a somewhat large scale from time to time, and from a familiarity with most of the conditions of water supply in different parts of England, including that from the magnificent series of rocks in the north, from which was obtained a large supply for gravitation works. It was of comparatively small importance to endeavour to learn the exact position of the water in these rocks. No doubt the water supply to be obtained from rocks greatly depended on geological conditions, some rocks, owing to faults in the stratification, giving it up freely, and others, though holding water, not delivering it very easily. These were questions in many cases of a purely local character, and where they were not purely local, it was almost impossible to generalize in such a way as to insure any useful result.

The time might come when a generalization of the kind might be possible, but it had not yet arrived, and he did not think that Mr. Lucas's endeavours towards the establishment of a theory susceptible of general application was likely to be very helpful. To return to the chalk. He thought it might be taken as absolutely proved that water was contained in chalk in enormous quantities, in the substance of the rock itself, but these enormous quantities, were not available. Water was also contained in very large quantities amongst the fissures in the chalk, which communicated occasionally with each other—sometimes freely and sometimes with great difficulty—and it was entirely from the water contained in those fissures, and not from the water contained in the mass of the chalk, that the supply was obtained. The water entered the chalk freely enough—chalk was very absorbent

—and water running into the mass of it, filled it up entirely. It did so with all limestones, except when in the crystalline form, but limestone was a rock particularly liable, in all its forms, to fissures which communicated more or less one with another, and it was to those fissures, as he had said, that one must look for supply. When, therefore, the levels of wells were taken (and this was the chief object of Mr. LUCAS's work), if these levels were not taken where the fissures freely communicated with each other, they were of very small value. The water entered at one place and filled the fissures there, and if those fissures were localized, the water remained there. The endeavour to communicate from one fissure to another, by making a deep well and driving adits in a certain direction to effect such communication, would evidently be a failure unless the fissures happened to be tapped. Unless this were the case, very little more water would be obtained from adits than would be got from the bottom of the well. It was quite evident that the levels of the wells in the chalk districts not connected by fissures had no reference to each other, but had reference only to the local rainfall and the local drainage.

He would say something also with regard to the passing of material from the surface into the deep wells. In those cases in which the chalk was covered, as it often was, with London clay, or with boulder, or alluvial clay, the surface drainage did not enter it, and the chalk contained nothing but water which passed over the surface comparatively clean. The case, however, was different where the wells were situated in valleys containing considerable centres of population, or where the space between the uppermost surface and the chalk was filled with gravel which easily allowed contaminated surface waters to percolate through it, and drain down into the mass of chalk, and occupy the fissures.

In such cases the sources of the water were rendered impure. It must not, therefore, be considered that all water obtained from the chalk was obtained from one source or one great reservoir of unquestionable purity; and to this point he also desired to direct attention, in speaking of the chalk. No doubt the levels of the wells would agree approximately in certain districts, and would give some idea of the surface of the water beneath the earth; but there was really no continuous surface level, and, therefore, it must not be taken for granted that all the water obtained from the chalk, or any other rock, was necessarily of the same nature, nor because it was found that one part yielded a good and abundant supply, must it be assumed that the rest would also do so.

The REV. J. C. CLUTTERBUCK (Visitor) had listened with great pleasure to the remarks of the last speaker with reference to the condition of the water in the chalk. He believed it to be absolutely correct, as Professor ANSTED had said at a meeting of the Institution of Civil Engineers, that the chalk was saturated with water, even to its lowest depths, and gave off at the surface an inconceivably large amount, by evaporation. This was a very important point to bear in mind, because, if true, it indicated the presence of large quantities of water contained in the substance of the chalk.

As to the continuous level of water in chalk, he might observe that for the last thirty-five years he had repeatedly measured the same wells, and had found, as a rule, that a continuous level was distinctly traceable—so much so that in a line of wells with which he was familiar, the ratio of rise and fall was maintained so closely that, having measured one well, the level of all the other wells could be told to an inch. This he had proved again and again. He was aware that there were anomalies in the chalk—in the chalk in

Hampshire, for instance. The great well at Southampton might be called a gigantic failure. He asked the person who dug that well, or part of it, what he found—whether he penetrated lines of flint. The answer was, “No; we found the flints only here and there, like plums in a pudding.” What was the inference? Was it not that there were no open fissures through which the water could pass? He was once called on by Sir CHARLES WOOD to go and examine a well at Haslar Hospital, in which a fracture had occurred, and which was yielding salt water instead of fresh. He was informed by the Dockyard people that they had bored to an immense depth without success, passing through the tertiaries and the chalk. These, however, were mere anomalies.

He had been in the part of the country referred to by Mr. GRANTHAM, and had found great difficulty in tracing the water. A friend of his, who wanted a supply of water, had written to him on the subject, and he found that the stratification was so confused as to render the problem exceedingly complicated. There was none of the regularity which characterized the chalk strata. The supply of water in the district was from the oolites and the upper body of the lias. The first bed was clay, below which was the marlstone, and then the lower lias clay; and it was in the fissures where they intersected these strata, that the water was found, and fell out over the lower clay. There were some curious phenomena connected with the river Churn. His old friend, Mr. JAMES SIMPSON, was called on to examine a very intricate question as to the loss of water by the river Churn; and it came out as a fact that, at low water times, less water flowed into the Thames than rose at what was commonly called the Seven Springs. There was an actual loss of water. Close to the Thames Head there was a steam-engine, which was supposed to pump up two

(20)

million gallons a day; but as there was an immense loss in the bottom of the canal, only a portion of the water pumped up was realized, if he might use the term. His views on the chalk-water system would be found in a Paper read by him at the Institution of Civil Engineers, in the year 1842, and another in the year 1843. To these opinions he still adhered. He had reason to believe that the greatest quantity of perennial water which entered the Thames above Oxford, issued from the chalk stratum. This alone rendered the water-supply from the chalk excessively important; for it might be said, "No chalk, no Thames, no London." If the supply from the chalk were to fail, the river would soon cease to exist.

Next, as to the so-called bournes and dew ponds, respecting which he spoke with some diffidence, though not, perhaps, with so much as regarded the bournes, for he had taken what was commonly called "the trouble" of investigating several bournes. There was a place called Lambourne, on the downs of Berkshire, where there was a very remarkable bourne, which was supposed to break out once in so many years, and he found, on looking over the pages of the *Gentleman's Magazine*, a most extraordinary representation of what the persons there thought was an underground reservoir, which he need hardly say was purely mythical. The question was, how and why these bournes broke out? In a memorandum which he wrote for the Ashmolean Society at Oxford, he explained it in this way. "When the localities in which these bournes burst are accurately surveyed and levelled, it is found that the point at which they appear above the ground is depressed below the angle at which the water lies in the chalk stratum." Now, he thought it was an acknowledged fact that no underground water was flat—it was always draining off to some outfall—and as it drained to the outfall, it took an inclination, and

that inclination or angle was in proportion to the distance of the outfall, and if the angle of the underground water rose above the surface at any point where the surface was depressed, the bourne would break out at that point.

It was a curious fact, which he might mention, that between the three months ending December, 1852 (known as the great flood year in the valley of the Thames), and the same period ending 23rd January, 1877, there had been an extraordinary identity as regarded the height of the floods and the bursting of the bournes. The total rainfall recorded by him was 12·22 inches in the one year, and 12·16 in the other. In both cases the bournes burst exactly eighteen days after the Thames had attained the greatest height in flood.

A few words as to dew ponds, in which it appeared that Mr. LUCAS did not believe, contending that their permanence was due to the presence of a certain amount of sand, or sandy clay, through which the water percolated. Now, in the dew ponds, which he (Mr. CLUTTERBUCK) had observed, no such conditions existed. They were entirely on the spurs of the open downs, and an examination of them would show that there was nothing between the turf and the surface of the chalk, except a small quantity of earth or mould, and it was physically impossible that there could have been any drainage into those ponds. He spent two whole nights on those downs (which perhaps was more than any other person present could say), in company with a particularly intelligent friend of his, and they took the temperature of the ponds and of the air throughout the night. There came a wind which seemed to baffle their attempts just after the sun rose, so that they could not carry on their observations further; but when they came to make their calculations there was a great balance in favour of the pond. They first of all took the number of sheep which they found every day

drinking from a pond, and made allowance for the rainfall during a certain period ; but, notwithstanding every possible allowance, they found, as he had said, a balance in favour of the pond. He, therefore, had come to the conclusion that the permanence of these ponds was unaccountable. A very intelligent friend of his had told him that early in the morning he had seen the mists, as it were come round those ponds, and acquire a sort of rotary motion over them, and that he had witnessed this phenomenon over and over again. He could not account for it. The sheep drank at these ponds, and consumed a large quantity of water. He had a flock of sheep of his own, and had found, giving them dry food and no roots whatever, that they consumed ten pints of water per day, the water being carefully measured and the number of sheep known. The only conclusion he could come to was that there was something in the question which had hitherto baffled investigation, and which was apparently inexplicable.

Mr. E. P. SQUAREY (Member) had listened with pleasure to Mr. CLUTTERBUCK's able remarks on the mist or dew ponds on the chalk hills. He (Mr. SQUAREY) lived on the chalk district, and could not only confirm what Mr. CLUTTERBUCK had said with reference to these ponds, but could point to instances in which they had been made to provide water on the chalky hills of Wiltshire, Hampshire, and Berkshire. He could show Mr. LUCAS several natural ponds which he had known for many years, and had often visited as a matter of interest, on the highest chalk and other hills in the foregoing counties, and in Dorset, situated in slight natural depressions of the ground, and which, even in the most drougthy seasons he had never known to be dry. He could not help thinking that these natural mist ponds, suggested,

probably, the made ponds in the counties he had mentioned. There was a remarkable mist pond on an estate of which his firm had the management, near the scene of the autumn manœuvres of 1872. It was situate at a lofty point to which there was no possible run of any kind; yet at a period when one of the bournes to which Mr. CLUTTERBUCK had referred had given out the last drop of water, and when even the wells were dry, the inhabitants of the neighbouring village resorted to it for water for themselves as well as for their sheep. He could give no better proof of the capacities of these mist ponds.

As regarded the water yield from chalk, his experience was limited to a portion of the area comprised in that formation. So far as the extreme south of England was concerned, he was disposed to believe that there were no fissures in the chalk, inclining rather to the belief that the water supply of the chalk was held in it and in the green-sand as in a great sponge, and that when a rainfall such as that of December and January last saturated the chalk and the green-sand below it, the springs broke out in great volumes, and flowed with remarkable permanence, owing to the capacity of the chalk and sand to hold an immense quantity of water in its pores. A spring which broke out just where the chalk dipped under the tertiary near Salisbury was extremely interesting. He had known a difference of level in the pond fed by that spring (which had been hollowed out for the purpose of water supply for sheep) of some thirty feet, within something like sixteen or seventeen days, and it formed a perfect water-gauge for that district. The chalk dipped at the point he was alluding to, whilst its northern side terminated in a large escarpment resting on the green-sand.

He begged to tender his thanks to Mr. LUCAS for his

Paper, and trusted that he would pursue his experiments, and multiply them, not only for his own use, but for that of the public generally.

Mr. S. C. HOMERSHAM would be glad to offer a few observations which occurred to him in reading the Paper. At page 154, Mr. LUCAS spoke of the rain degrading the chalk and washing the surface from the hills to the valleys. Now, no doubt the rain had a certain effect in that way; but, so far as his experience went, frost was a much more active agent in the process of degradation, as could be seen by any one who examined a railway cutting through chalk after a severe frost. Rain might assist to bring it down, but frost broke wet chalk into small pieces, and thus enabled the rain to wash it from the higher to the lower ground.

Some allusion had been made to the percolation gauge established by the late Mr. DICKENSON, and continued by Mr. EVANS. He did not know that it would be very interesting to go deeply into the subject, but he wished to point out that Mr. CLUTTERBUCK had erroneously called this gauge a Dalton gauge, for in point of fact it was no such thing. Dr. DALTON, some eighty years ago, used a gauge consisting of a metal cylindrical vessel ten inches diameter and three feet deep, the lower part of which he filled with layers of gravel, sand, and soil, covered with grass on the top, leaving some two inches between the surface of the upper layer and the top of the gauge itself. To the outside of the gauge, at the level of the uppermost layer, he connected an overflow pipe, and to the bottom of the cylinder another pipe. The water which fell on the surface, and passed through the layers of grass, soil, sand, and gravel, was caught in a bottle below, while that portion which flowed off the surface ran through the overflow pipe into another bottle at the side. Thus DALTON measured both the water which percolated

through the soil, and also the water which flowed off the surface. From those two sources, and the use of an ordinary rain gauge, he estimated the proportion of the rain that could supply rivers and underground springs. But, in Mr. DICKENSON's gauge, the water from this overflow pipe was eliminated. The consequence was, that when the gauge was exposed to heavy rains, the water flowed over the top of the gauge, and escaped, thus rendering it impossible to ascertain the loss by evaporation. Thus, though Mr. DICKENSON's gauge had been called a Dalton's gauge, it was not made according to Dalton's method, and he took great exception to the proposal to deduce the amount of evaporation from a surface of earth by the use of such a gauge.

The author of the Paper, at page 161, in speaking of subterranean water, said that the prime indicator of the existence of subterranean water was a spring, &c. Now, he Mr. HOMERSHAM, had long been in the habit of selecting sites for wells to supply towns and other places with water, and the first locality where he would look for subterranean water would be one where there was no surface water or spring. He could indicate 200 square miles of country, in one patch, where there were no springs or water to be seen on the surface except after heavy rain, and even then, though the weather might have been exceptionally wet for months, nothing in the nature of boggy or marshy ground was to be met with. Now, in country of that description, situated on chalk and other absorbent geological formations, one never failed, if proper judgment were exercised, to procure a supply of water.

Six or seven miles south of Croydon, both to east and to the west as far as the out-crop of the gault clay, no surface water was, as a rule, to be met with. The whole of the rain which fell on the chalk formation was absorbed as fast as it fell. The springs from the upper green-sand, though

pretty numerous, were small in quantity. The greater proportion of the subterranean water flowed north towards Croydon from the hills at their escarpment near Godstone, where the tops attained an altitude of 500 or 600 feet above the sea. The whole of the rainfall sank into the ground till arrested by the gault clay below, and, then as it were, slid forward very gradually. At Croydon, wells had been sunk, which at one spot yielded some five million gallons per day. The whole of that town was supplied from these chalk wells, and at St. Mary Cray, a well yielded four or five million gallons per twenty-four hours. West of Croydon, and to the north, there were other wells, yielding five or six million gallons per day; so that in that portion of the chalk formation shown on Mr. Lucas' diagram it appeared not only that there was water which could be got at, but water which had been got at for the last fourteen or fifteen years, and which supplied Blackheath, Charlton, Deptford, Greenwich, Plumstead, Woolwich, and Dartford.

In the north of London, again, the New River Company had long been using wells to supplement the Amwell and Chadwell Springs. The whole of Hull and the country round (supplied at one time from the river) now drew its water from wells sunk in the chalk. Across the channel, the City of Paris had gone eighty miles to fetch water from the chalk, Paris being situated in a basin geologically similar to the London basin.

The subject of the maintenance of ponds was an interesting one. No doubt many ponds, especially when constructed for breeding and fattening fish, depended on springs; but the large majority of them were simple excavations in the earth made watertight, for the purpose of storing flood water from roads and ditches. The ponds in the Chalk Downs to which reference had been made, varied in different

localities from 30 to 45 feet in diameter, and had a surface sloping towards the water. Assuming the pond itself to be 25 feet in diameter, and the sloping side to be 50 feet in diameter, the collecting surface of the pond was four times the area of the pond itself: so that if the pond were 5 feet deep, and a foot of water fell over the whole area of slope, four feet would be added to the depth of the pond. The sloping ground round these ponds was more or less puddled, and afterwards maintained water-tight, partly by the tramping of sheep, to conduct the water into the pond instead of absorbing it. Many ponds which he knew of were specially made to collect water in this way.

The author of the Paper had spoken of the upper green-sand, which, as all were aware, was a formation immediately above the gault clay and below the chalk marl. The chalk marl was to some extent impervious, except at the surface, where the frost so broke it up as to render it quite as absorbent as any other part of the chalk; and on going over the country after heavy rains it would be found that every drop of the water which fell upon it was absorbed. He did not think there was any sufficient reason for separating the subterranean waters of the upper green-sand from that of the chalk marl, as the latter was so broken up by perpendicular fissures. Geologists, heretofore, had invariably treated the subterranean water as held up by the gault clay, and he thought the author of the Paper would, on consideration, see reason to alter his views as to separating these various strata into different water-bearing systems.

Some reference had been made to the effects of under-draining in increasing the floods. A way had been in use for more than a century past of getting rid of surface water without so doing, in places where large and thick strata of clay lay upon chalk. This consisted in sinking

what was called a dumb well through the clay into the chalk, and filling it up with flints, or stones, or hard chalk, which was porous. This formed an absorbing well, into which the subsoil drainage was conducted by means of small tile-drains, and the water then passed down into the body of the chalk. This method diminished instead of adding to the intensity of the floods. He was surprised, some years ago, when he had occasion to get up evidence for a Parliamentary Committee on the subject, to find that there were families who, for two or three generations, had made the sinking of these dumb wells their regular vocation. He believed that the system had been and was carried on to a much larger extent than any one who had not had occasion to make himself specially acquainted with the facts would imagine.

The author of the Paper had spoken of unsuccessful wells. He (Mr. HOMERSHAM) wished he would give some instances of such wells. He had been engaged for the last twenty or thirty years in supplying towns with subterranean water, and he could mention numerous towns which were once supplied from rivers, but now by means of wells—such as Birmingham, Canterbury, Cirencester, Hull, Nottingham, Woolwich, and many other places. He would be surprised to hear of any instance in which towns once supplied from wells had abandoned them in favour of river supply.

A large portion of the south of London was supplied by the Kent Company with water drawn direct from wells sunk down deep into the body of the chalk. The New River Company also drew a large portion of their supply from the Amwell and Chadwell Springs, issuing from the chalk, supplemented by wells in the same formation, but it was brought in a barbarous way to London through a highly cultivated district,

in an open earthen channel, and reached the consumers much contaminated, though free from sewage pollutions. The great bulk of the Thames water also came from perennial springs flowing from the chalk, and it was not now the question whether London could be supplied from the chalk, but whether or no the water taken from the chalk strata should be supplied in its natural purity, or after it had suffered contamination from the slop pails emptied into it by a million of persons. Two or three years ago, the question of supplying Bushey by means of chalk wells, was raised before a committee of the House of Lords. One of the principal opponents of the scheme, was Mr. EVANS, a paper manufacturer, and when the question was put to him, "Where would you take the water from?" he answered, "From the river Colne." What were the facts? These millowners took the pure water from chalk wells for the manufacture of their paper. Nothing but the purest water would do for their purpose, and having polluted it with their refuse, passed it into the river, and then had the modesty to ask the authorities to filter it and supply it for drinking.

The wells in chalk which were sometimes unsuccessful, were those sunk in places where the London clay overlaid the chalk, such as wells sunk by the London brewers and others, through a superposed stratum of clay 150 feet or so in thickness. The water derived from chalk so situated, was very different in quality from that furnished by the chalk where it was and had been for countless generations exposed to the rains of heaven, and which had thus had all the soda salts washed out of it. Chalk covered by the London clay was not free from soda salts, like water drawn from the exposed parts of the formation. The soda was, no doubt, derived from the seas in which the chalk was known to be formed.

Mr. C. GREAVES (Visitor) considered that Mr. LUCAS was entitled to thanks for preparing a Paper which dealt so clearly with certain methods of ascertaining in different parts of the country the state of the water supply in those strata to which he had devoted special attention. He did not think, however, that much would come of it, at any rate for the present. At some future period it might be possible to estimate, from periodical measurements extending over a series of years, whether the general supply was being increased or diminished.

He quite agreed that a great supply of water was contained in the fissures of the chalk, but was unable to adopt the view of some who were of opinion that water passed in large quantities through the chalk mass. It had been said, and it was true, that chalk itself was used to puddle the bottom of the so-called dew ponds, and he had even known cases in which chalk was worked and rolled so as to form a very good holding reservoir. He was at a loss to see how it was possible (there being no alteration in the nature of the chalk) that it could be at one time retentive and at another time so porous as to allow unlimited quantities of water to pass through it with rapidity as some people supposed. No doubt a small quantity would pass through it slowly—there was no reason why it should not—but much more slowly than in the case of many other substances.

It was very gratifying to find that the study of this subject was so much on the increase. When Mr. DALTON first applied himself to the question, he wrote a Paper in which he described the percolation gauge made by him and by his friend, Mr. HOYLE. As had already been said, the gauge had a pipe from the top and a pipe from the bottom; but it did not seem to give very accurate indications, for the water which flowed off from the top had nothing to do with

the percolation, and the only truthful results were obtained when the soil in the gauge had settled so as to get below the mouth of the upper pipe, so that the lower pipe took the whole of the percolation. He had the honour last year of reading a Paper before the Institution of Civil Engineers on the subject of percolation and a gauge, in constructing which he endeavoured to improve, to some extent, on the percolation gauge made by Mr. DICKENSON and Mr. EVANS. In his own percolation gauge he avoided altogether any chance of the water being led away from the surface, and therefore probably secured a more accurate result than any likely to be obtained by two pipes or two separate series of measurements. He believed it was a fact that the rivers in this country did not receive more than twenty-five per cent. of the rainfall, and the maximum percolation did not amount to more than one-fourth of the rainfall. The percolation on a square yard of soil selected at random was, of course, a very different thing from the percolation in a gauge, of the same area, which was designed to represent, say, 500 square miles of country.

It was possible to examine every grain of the cubic yard of soil of which the gauge was composed, and so refusing sand or clay to make it a good average representative; but, after all, it should be remembered that the soil throughout the country was artificial. How many times, for instance, had it been drained and cropped; how many times had all kinds of roots been dug out of it, and manure put upon it? Therefore, the artificial conditions of the gauge were not necessarily such as to render its records unreliable when contrasted with the soil. In the pastures there was, no doubt, something which the artificial gauge did not represent; but it must be borne in mind that the ancient pastures, except the chalk pastures, formed no large portion of the soil of the country. The main point in

which the artificial gauge differed from nature was in the fact of its possessing a level surface. The ordinary soil had all manner of inclinations, and where the slope was great the water went off rapidly into the rivers, and had no chance of percolating through the soil. This was the case in the northern counties—in Lancashire and Yorkshire, where the slopes were frequently 1 in 4 and 1 in 5; while in home counties the quantity of water which reached the rivers by flowing over the surface was not more than twenty-five per cent. of the whole rainfall.

MR. ROGERS FIELD (Visitor) would wish to ask Mr. CLUTTERBUCK one question. He had mentioned that he had taken the temperature of the dew ponds. Was the temperature warmer or colder than that of the surrounding air?

MR. CLUTTERBUCK replied that throughout the whole night it was decidedly warmer than the air. He had written to a friend of his who took the temperature, for the result, but he had not been able to lay his hand on the record.

MR. FIELD: That would agree with what he was going to say. He had been making, for some years past, some considerable experiments for the Royal Society on the subject of evaporation, and had, among other apparatus, a large tank in operation in which he took the evaporation measured by a self-recording gauge, which gave for every hour or minute of the day the amount of rise or fall of the surface of the water in the tank. A rise implied rainfall or condensation, a fall implied evaporation. The rainfall was measured at

the same time by a rain-gauge, and the temperatures taken of the water and the air. The general result as regarded condensation was, that there was occasional condensation, but only slight,—certainly not sufficient to account for any large amount of water supply. Of course, the difference of locality between that tank in an open field and a dew pond on a high chalk hill, might make a corresponding difference in the amount of condensation. At the same time it was evident that as long as the temperature of the water was warmer than that of the air (as when Mr. CLUTTERBUCK observed it) there could be no condensation. He thought it highly desirable that any gentleman who had the opportunity should make observations as to the rise and fall of water in these dew ponds. He believed that the amount of evaporation was much less than was usually supposed. It had generally been put down at from 30 to 40 inches per annum, but the observation with his tank only showed 20 inches, and this amount agreed with Mr. GREAVES' measurement. With 20 inches of evaporation, and 30 inches of rain, there would remain 10 inches of rain to the good, and if one took into account what Mr. HOMERSHAM had stated, that there was always a sloping surface round the edge of the ponds, their maintenance in water would be, to some extent, accounted for.

He could not help thinking that it was possible to discover whether the amount of water in these ponds really increased in the night by condensation or not. Connected with his tank, he had a little hook which slid up and down in such a way that one could see precisely when it came into contact with the water. It was very easy to measure, by its means, the level of the water to the one-hundredth of an inch, and to ascertain whether there was any alteration or not. The

use of some such apparatus would surely enable one to ascertain the truth about these dew ponds.

On the motion of Mr. R. W. HALL, the discussion was then adjourned to the next meeting.

REFERENCE

TO

MR. BRAVENDER'S SECTION OF THE BOXWELL SPRING.

(Referred to on page 187.)

- (A) Kelloway and Oxford Clay, dropped down rather more than the thickness of the Great Oolite, which pens back the water accumulated on the Fuller's Earth and causes it to ascend the Fault and discharge at and from Boxwell Spring, at a point about 120 feet above its source, the Fuller's Earth.
- (B) All this portion of the Great Oolite may, in wet seasons, become saturated by the damming up of the water on the Fuller's Earth by the Oxford Clay, at the Fault.
- (c) Formerly hills of Kelloway sunk down to "A," and since partly denuded by the current which formed the Valley of the Churn.
- (D) Depth of Water, 26 feet in Winter, and 9 feet in a dry Summer.

From the Thames Head Engine to Boxwell Spring, eight Locks, at 8 feet fall each=64 feet fall, by Canal.

Discharge of Thames Head Engine 3,000,000 gallons in 24 hours.

Discharge of Boxwell Spring 1,500,000 to 2,000,000 gallons in 24 hours.

AT
THE ORDINARY GENERAL MEETING,

Held on Monday, March 26th, 1877.

THE PRESIDENT IN THE CHAIR.

The adjourned discussion on the Paper by Mr. J. LUCAS, entitled "Hydrogeology; one of the Developments of Modern Practical Geology," was resumed by—

Mr. T. SMITH WOOLLEY (Vice-President), who said that at the last Meeting he made a statement as to dew ponds generally and those in Wiltshire in particular. The subject had been comparatively exhausted by the remarks of subsequent speakers, but it might not be out of place if he ventured to read a letter which he had received from a very practical man, a tenant on a property which he managed in Wiltshire, to whom he had written, with the view of eliciting the notions of the farmers who were practically familiar with the subject. The letter was as follows:—

"I have much pleasure in replying to your queries. Large puddled ponds on downs retain water through long periods of drought; the waste is supplied by the power of attraction contained in the water in such situations which draws or attracts a continuous supply from the fogs or mists.

"I have known such ponds where a thousand sheep have been watered in seasons of drought, and yet never dry. They should be made on the most elevated points, and be rather shallow, extending over a considerable surface. When the ponds are newly made, some water must be

carted to them, sufficient to draw the mists. People, as a rule, do not make their ponds large enough, and, consequently, in exceptional seasons, are disappointed. The puddled pond I made at Rabson takes the runnings from several yards of road, and nothing will beat this plan where circumstances allow."

This was the farmer's theory, and it seemed to him by no means a bad way of translating the science of the thing into common English. It might be taken to be beyond all question that these ponds were kept supplied through very long periods of drought by some natural agency, and he could not conceive any other than that suggested by Professor ANSTED in scientific language, and by his friend, the tenant farmer, in more homely phrases.

The HONORARY SECRETARY read the following communication from the Rev. J. C. CLUTTERBUCK, who was desirous of supplementing his remarks at the last meeting with reference to dew ponds :—

"When a dew pond is finished, it is necessary to introduce water by artificial means. This is usually done by collecting snow and filling the pond, piling up the snow in it. When the snow is drifted by a strong wind, flaked or wattled hurdles have been so placed that the snow accumulating against them readily fills the pond; if there be no such opportunity, for lack of snow, other means must be resorted to. Ponds which have held water for years, but which through stress of drought have become dry, will remain so if water be not artificially introduced. This seems to dispose of the question of such ponds being dependent on their supply from rainfall alone."

Mr. BALDWIN LATHAM, F.G.S. (Visitor), said that he had read Mr. LUCAS's Paper with considerable interest. All

knew that Mr. LUCAS had taken a very large amount of trouble in investigating what he termed the Hydrogeology of the country.

It appeared that at one of the previous Meetings some objection had been raised to the term (Hydrogeology) but he thought that Mr. LUCAS had been extremely fortunate in the selection of the word he had adopted to define the particular class of investigation which related to the movement and quantities of water in all geological strata, and the name was so appropriate that he thought it would for ever remain a useful term in connection with engineering investigations.

He was glad of this opportunity of saying how deeply he was indebted to Mr. LUCAS for the very great trouble he had taken in investigating the water supply of a large extent of country with which he (Mr. LATHAM) was especially associated. The observations recorded by Mr. LUCAS had been of great value to him in his endeavour to acquire information of the past condition of the springs of a large district; and, in fact, the only information relating to portions of that district, he had found in the records made and published by Mr. LUCAS. The subject was, at present, entirely in its infancy, but it had most important bearings on the interests of mankind.

With regard to the experiments of Mr. LUCAS, mentioned in the Paper (he alluded to those with sand and water), it appeared to him that there was very great difficulty in drawing a line, so as to distinguish capillarity from friction in those experiments. Friction was the resistance offered to water passing through the filtering medium, but capillarity was the power of the medium to draw water to itself, and there was a great difference between the two, which the experiments did not define. What was called capillarity by Mr. LUCAS, he (Mr. LATHAM)

would call absorption, as he took the word absorption to mean the retention of water in the way that a sponge would absorb and retain water. When he (Mr. LUCAS) had got rid of the surplus water held by friction or capillarity, he put that down as "absorption;" he also called the total quantity of water held by the vessel containing the sand—"absorption." The same word used to express different quantities was confusing to his mind.

It had been shown in the experiments that the water which had drained from the sand, if poured rapidly back on the sand filter, brought away with it a larger volume of water than the volume of water poured on to the filter. This increase was probably due to the fact that, when water was rapidly poured from one vessel to another, it carried with it a large amount of air. It was shown by pouring out a glass of beer; the beer poured from a jug carried into the glass a certain amount of air which rose to the top of the glass and formed the froth. It was the same thing if water were poured into water, especially if it were impure, bubbles being formed on the surface. Again, the same principle was made use of in Sprengel's air-pump, where mercury was used as the medium for producing a vacuum. So the pouring of water rapidly on to a mass of sand surcharged with water would carry into the sand a certain amount of air, which would itself displace a certain volume of water and this would account for the displacement which occurred in the experiments by Mr. LUCAS. It was a very uncertain part of the observed rainfall in any district which really affected the springs. Very little was known with regard to the percolation of rainfall into the ground, and experiments only extended to a few feet from the surface. The old three-foot Dalton gauge gave a much larger amount of percolation than the recent and deeper gauges used by Messrs. Dawes and Gilbert; so that it was reasonable to suppose, when one

had to deal with several hundred feet of strata, that the amount of percolation would be very small indeed.

The best proof of this was shown in the diagram exhibited.* He had made observations on the flow of water off three chalk drainage areas within the last two years. The diagram referred to a large drainage area which had its outlet into the Wandle at Croydon. The firm line, commencing in March 1876, represented the amount of water discharged, and each of the horizontal lines represented one hundred cubic feet per minute; but he must state with regard to the observations that, owing to the water being collected in a culvert under the town of Croydon, the quantities gauged on week days were to a certain extent interfered with by reason of the amount of water poured into this culvert from manufactories, and also by reason of a small amount of drainage from the roads turned into the culvert. It therefore became necessary, in order to avoid serious errors, that the observations should be made on Sundays, and the whole of the results shown in the diagram were Sunday gaugings, which were, consequently, not affected by the water from the factories. The gaugings were to some extent affected by the rain which may have fallen at the time of the experiments, and on that account he had felt it very desirable, in order to ascertain what was spring water and what was rain water, to take the temperature, which was a sure guide in distinguishing spring from other water.

From the temperature (shown in a fine line on the diagram), it was at once seen when a certain quantity of warm or cold rain entered the culvert. Each of the horizontal lines in the diagram represented 5° Fahrenheit. The normal temperature of spring water did not greatly vary;

* For this diagram, see page 232.

52·5° was the highest temperature of spring water that had been observed, and 50·0° was the minimum temperature of spring water flowing off this particular drainage area. Observations of temperature, together with the quantity of water flowing, showed at once whether spring water, or rain or other water, were being dealt with.

The dotted line in the diagram represented the height of water in a well at Selsdon Road, outside the town of Croydon. The datum line was 156 feet above Ordnance datum, and each of the horizontal lines represented 1 foot in altitude. It would be seen from the diagram how closely the rise and fall of the water in the strata, as represented by the gaugings of this well, followed the increase or diminution of the quantity discharged. The peculiar broken line in the quantity discharged in the month of February was due to some experiments made at the Croydon Waterworks, and which showed still further what an intimate connection existed between the flow of water from springs, and the relative volume existing in the strata for the time being. Some of the fluctuations shown in the diagram were due to the effects of rainfall, and were found in the gaugings of other drainage areas. The gaugings showed what an intimate connection existed between the amount of water in the strata, and the flow from the springs, and how it was interfered with by artificial means.

In the spring of 1876, there was a small bourne flow in the Caterham Valleys; the surface flow, however, did not reach Croydon, and the maximum flow into the River Wandle at Croydon, was about 450 cubic feet per minute. There was a bourne flow at the present time in the Caterham and Brighton Road Valleys, but it was much more copious than the flow of the previous year. It had been stated that these bourne flows occurred at stated intervals of time, but, as a fact, there was no fixity in the period of

these flows. Mr. SYMONS had pointed out that he (Mr. LATHAM) had been able to predict the exact period and place of the present bourne's flow, but it was really no prophecy. Many people thought it a curious fact that the bourne should begin to flow on the very day he had foretold. The real fact was that he had been carefully observing the rise of the water in the valleys, and knowing the exact height to which the water must rise to cause a flow of the bourne, and knowing the rate at which it was rising, it was a comparatively easy matter to calculate a fortnight beforehand when the bourne would flow. The most astonishing thing relating to the present large bourne flow was the ignorance displayed by those who had hitherto been looked upon as authorities, and who declared that it was impossible to have a bourne flow this year, because there had not been the traditional amount of rainfall in the previous year.

The present bourne flow showed that it did not do to lay down hard and fast lines as to the amount of annual rain which was necessary to cause a flow; in fact, the yield of the springs was only affected by the rain falling in very limited periods. It was clear, looking at the diagram, that the rain of last year, after May, did not appear to have affected the springs in the slightest degree, for in spite of the rain the water kept diminishing. He was not going to say that if there had been no rain, less water would not have flowed off. Rain might exercise a mechanical influence and drive water out from the lower strata, for if it fell on the surface and completely closed the whole of the interstices the effect would be to compress the air between the upper level and lower level of the water, and this would have some influence in expelling the water from the lower strata; but there was no direct evidence of such action in the great area of the chalk formation, for the $1\frac{1}{2}$ " of rain which

fell on the 23rd December last gave no immediate result in the flow.

It would be observed from the diagram that there was a very steady rise in the well from the beginning of December, and that the maximum flow from the springs occurred about St. Valentine's Day; so that they had passed in a very short space of time from the lowest to the highest level. The delineation of the flow of water off a drainage area, or the rise and fall of water in a well within that drainage area, was represented by a wave line, which rose very abruptly and then gradually declined. The results shown on the diagram corroborated the same facts he had observed in gauging wells some years ago, and which he published in *Papers on Supply of Water to Towns*. Bourne flows followed the same rule—*i.e.*, soon after they commenced to flow they arrived at their maximum discharge, and then gradually declined. This was the case with the bourne which was now flowing. The quantity of water yielded by the drainage area of 23 square miles, discharged at Croydon, including the quantity of water pumped at the waterworks, in November last, did not exceed 2,400,000 gallons a day. The maximum flow was over 21,000,000 gallons a day in February. To his mind, the test of the yield of a given area was the yield at the minimum period of the year. The strength of the chain was judged by its weakest link, and that was the case with water-bearing strata—one must judge of their yield, from the minimum quantity which would flow off.

Some very pithy observations were made by Mr. CLUTTERBUCK with regard to the Thames. He said it was principally supplied by springs, and that the chalk was the source of the springs, and, consequently, the principal source of the Thames. It had been suggested to take a large quantity of water direct from the chalk rather than from the

Thames, but there was always a difficulty in carrying on extensive pumping operations in any strata of which the water yielding limits were not clearly known. For example, it was a well-understood fact at the present time that the principal part of the supply from the chalk strata under London, was in reality water which flowed back from the River Thames; that is, the exhaustive pumping had inverted the order of things, and instead of getting the water from the chalk formation, filtered Thames water was obtained. It was well-known with regard to many watering-places deriving their water supply from the chalk formation, that if the well was not located far from the sea-shore, exhaustive pumping was sure to bring in sea water. He knew a waterworks on the south coast where an analysis of the water taken in the morning, after a cessation of pumping, showed very little salt; but an analysis at night, after a hard day's pumping, showed fourteen or fifteen grains per gallon of common salt. Exhaustive pumping would invert the natural order of things, and, in some cases, impure water might, in consequence, be obtained.

There were also the faults in the strata to deal with. These faults greatly interfered with the flow of subterranean water. Through Croydon there happened to be a fault which threw up water and formed the River Wandle. At the gasworks at Croydon, a well was sunk many feet into the chalk, but it yielded no water at all. The chalk at the gasworks was covered with something like 70 or 80 feet of tertiary strata, whereas within a quarter of a mile of this site the chalk was found on the surface. The small inclination of the chalk in this neighbourhood, and the depth of the covering at this point clearly indicated the presence of a fault, and the River Wandle was the demarcation of that fault. The Ravensbourne was the

demarcation of another fault. The existence of these faults prevented any large body of water from flowing into the chalk, from the south, under London. The water was, in consequence of the faults, thrown out into the streams, and prevented from passing under London to furnish a supply, and the water in the London wells was now derived from the infiltration of water from the Thames.

With regard to another point mentioned by Mr. LUCAS, namely, the fluctuation of flow, which he stated at 10 to 1, that proportion held good with regard to the drainage area discharging at Croydon, but it did not hold good in some other drainage areas, in none of which was the fluctuation in flow so great.

He observed that Mr. HOMERSHAM had spoken of some wells at Croydon yielding 5,000,000 gallons a day, but he could not help thinking that he had been given some wrong information. At no time had more than 2,850,000 gallons been raised from the wells at Croydon Waterworks; and if 400,000 gallons were added to this quantity, the total quantity raised at Croydon would not exceed 3,250,000 gallons per day, which might be taken to be the maximum quantity. He would not say that the 5,000,000 gallons per day could not be obtained, but it could never be procured without, at times, carrying on exhaustive pumping, and there was always very great danger in carrying on exhaustive pumping operations on such a site as that occupied by the waterworks at Croydon. He thought the subject of Hydrogeology, in all its bearings, was one deserving of the fullest and deepest consideration, and he felt personally indebted to Mr. LUCAS for having taken up the subject, and for the information which he had imparted.

Mr. S. C. HOMERSHAM (Visitor) said that he had had occasion for the last twenty-five years to pay, he might

say almost unremitting attention to the question of the absorption of the rain which falls upon, and the amount of subterranean water to be obtained from, the chalk strata.

He held in his hand a skeleton map of the south-eastern portion of England which, many years since, he had constructed to show the position and area of the different geological formations appearing at or near to the surface of the country, and the whole length of the streams and rivers to be seen on the surface of these different formations. The map showed, (exclusively of a circle of $7\frac{1}{4}$ miles in diameter round London, and of the Isle of Wight,) the facts summarized in the following Table :—

GEOLOGICAL FORMATIONS.	Area.	Length of Streams and River Courses.	Lengths per Square Mile.
	Square Miles.	Miles.	Yards.
Crag	2,056	1,966	1,709
Bagshot sand	168	165	1,729
London and plastic clay	4,071	4,741	2,057
Chalk and upper green-sand	5,377	2,391	782
Wealden clay	763	905	2,087
Hastings sand	577	700	2,135

From this Table it would at once be seen that wherever chalk was at or near the surface, streams and rivers were very infrequent compared with almost any other geological formations. For instance, upon the chalk there were only 782 yards of river course per square mile, while upon the London clay there were 2,057 yards; but not only were the river courses much less in length upon the chalk, but, when fed by similar areas of drainage ground, they were much smaller in volume both in wet and dry

seasons. This would be seen by some drawings (exhibited) made to the same scale, of nine pairs of bridges crossing different rivers and streams. One bridge of each set spanned a river course with clay, and the other a river course with chalk, as the surface of the drainage ground. Each pair respectively had the same area, or nearly so, of square miles draining into the river courses above them. The following Table would suffice to demonstrate the facts which the drawings were intended to illustrate :—

TABLE showing the area through the arches of the Water-ways of nine pairs of Bridges crossing different streams and rivers. One Bridge of each pair having a drainage ground composed of the chalk formation, and the other a nearly similar area of the London-clay formation.

Situation of the Bridges, and the Names of the respective Streams and Rivers.	Area of Watershed or Drainage Ground in Square Miles.	Geological Formation.	Area of Water-way.	Observations.
	<i>Sq. Miles.</i>		<i>Sq. Ft.</i>	
Mountneysing, Essex, } River Roding . . . }	11½	London Clay	191	Often filled with flood water
Kimpton Hoo Park, } Herts, River Mimram }	12¾	Chalk	19	Never full of water
Chipping Ongar, Essex, } River Roding . . . }	21	London Clay	279	Often filled with flood water
Welwyn, Herts, River } Mimram }	23¼	Chalk	26½	Never full of water
Colney Street, Herts, } River Colne . . . }	39¼	{ London Clay . . . 28½ } { Chalk 10¾ }	267½	Often filled with flood water
St. Alban's, Herts, River } Ver }	38	Chalk	48½	{ Never two-thirds filled with water
Near Margaretting, Essex, } River Chelmer . . }	42½	London Clay	350	{ Bed of river and piers show signs of heavy floods
Park Street, Herts, } River Ver }	43	Chalk	65	{ Never half filled with water, except very rarely after heavy falls of snow
Writtle, Essex, River } Chelmer }	49	London Clay	358	{ Frequently filled with water after floods
Chalfont, St. Peter's, } Bucks, Riv. Misbourne }	49½	Chalk	40	Never half filled with water
Coggleshall, Essex, River } Blackwater . . . }	58	{ London Clay . . . 48 } { Chalk 10 }	179½	Often filled with flood water
Denham, Bucks, River } Misbourne }	56	Chalk	19	Never filled
Kelvedon, Essex, River } Blackwater . . . }	62	{ London Clay . . . 52 } { Chalk 10 }	390	Often filled with flood water
Stanborough, Herts, } River Lea }	61	Chalk	50	{ Never three-fourths filled with water
Stappleford Abbots, Essex, } River Roding . . }	79½	{ London Clay . . . 73½ } { Chalk 6 }	495	{ The water-way not sufficiently large to carry off ordinary floods. The country above is often flooded for miles
Hertford, Herts, River } Bean }	72	{ Chalk partially covered with impermeable drift }	173	Rarely half filled with water
Loughton, Essex, River } Roding }	99¼	London Clay	693	Often filled with flood water
Winchester, Hants, River } Itchen }	102	Chalk	187	{ Never two-thirds filled with water

Thus it became apparent that the area of the water ways of a bridge crossing a stream, fed from a clay drainage, was from five to ten times larger than that of a bridge crossing a stream fed by an equal area of chalk drainage, and this whether the drainage ground be comparatively large or small. On the Ordnance map exhibited, the respective sites of all these bridges were marked so that they might be readily found. These examples clearly showed the large amount of rain absorbed by the chalk. The only times, indeed, when floods occurred in the chalk districts, and those occasions were very rare, were when a very heavy rain over a large area of chalk hills had been quickly followed by an intense frost, and then by a heavy fall of snow combined with a sudden thaw; when the ground being frozen, and the pores of the chalk, as it were, blocked up with ice, floods occurred like those in a clay district, and bridges had been washed away; but it was not once in 100 years that the requisite combination of circumstances occurred to cause these floods in chalk districts. He understood Mr. BALDWIN LATHAM to say that he (Mr. HOMER-SHAM) was in error in asserting that 5,000,000 gallons a day were obtained from wells at one spot at Croydon. He could only repeat what he had said, and Mr. LATHAM would find, on enquiry, that the fact was as he had stated. It was true that not more than 3,500,000 gallons per day, perhaps, were ordinarily pumped, because at no waterworks was more water continuously pumped than was wanted for use.

There was, perhaps, one other point to which he might draw attention. The map before him contained a section* taken by levelling, and accurately drawn to scale, extending over the country from Aylesbury to the south-east, through

* For this section and the accompanying description, see page 232.

the Chiltern Ridge, Watford, Stanmore, London, and the River Thames, to the sea. This section showed the actual level of the subterranean water in the Chiltern Hills district, near the escarpment of the chalk. Not many miles from Aylesbury, the water was about 500 feet above the level of the sea. There was a well and waterworks in the Chiltern Hills, near Dancers End, which supplied Tring, Aylesbury, and other districts with water. They pumped the water there from a normal level of 500 feet above the sea, depressing the level 30 or 40 feet while pumping, but when the pumping ceased the water immediately rose again to its original level. The subterranean water in the chalk hills declined from its escarpment to the south-east, and at Watford was found to be 170 feet above the sea. Speaking from a merely casual inspection of the section, it might appear that the water at Watford would readily pass away through the thick stratum of chalk beneath the London clay, but this was not found to be the case.

The water in the chalk, under the London clay, was not usually obtainable in large quantities, and when obtained was of a different quality to that yielded by chalk which had been long exposed, at the surface, to the rains of heaven. The former contained carbonate of soda, sulphate of soda, and chloride of sodium, collectively amounting to from 40 to 50 grains per gallon, and hardly any carbonate of lime or chalk; while the water from the uncovered chalk strata, at Watford and Tring, was found to contain hardly any soda, and 17 or 18 grains of carbonate of lime. Why was this so? The answer was evident. Chalk, as was well known, was a formation composed of an aggregation of shells and corals, originating in ancient seas. A microscopical examination showed the calcareous shields and chambered shells of the animalcules termed foraminifera. The chalk, formed in the sea, perhaps many thousand millions of years ago, was

afterwards upheaved. Now, where the surface of the chalk had been exposed to the rains of heaven for countless ages, the soda salts had been washed out by the rain water passing through it, but where it was covered by a very considerable area and thickness of London clay, the salt had not yet been washed out, and the soda due to the water in which the chalk was originally formed still remained.

From Tring all the underground water flowed in the direction that had been indicated, but finding that it could sink to the level of the sea in an easier way than by passing under the thick clay beneath London, found its way there, probably, through the county of Essex; but that a large mass of subterranean water did continually pass from the chalk hills into the sea by underground drainage, there could be no doubt, as proved by the absence of floods. Extensive faults were found in the chalk formation, and enabled the subterranean water at high altitudes above the sea to pass down, in many instances perpendicularly, and thus get into the lower chalk, and upper green-sand (which last could conduct water more freely than chalk itself), where, upheld by the gault clay below, it got away to the oceans. It frequently happened that from the upper green-sand a supply of water could be got more readily than from the chalk itself. He had before had occasion to mention an instance of upwards of 200 square miles of country, where there was not a single river or stream to be seen, and he had marked on the map, which he had in his hand, 270 square miles in one patch, where there was no surface water whatever. By sinking a well-water could be obtained from below, but on the surface the whole of the water was absorbed. This district was along the top and sides of the Chiltern Ridge, as shown on the map, from near where the Thames broke through in a north-easterly direction, to Dunstable.

Mr. BALDWIN LATHAM would like to add that he had made many experiments with regard to the quantity of water-yield at Croydon, and the largest quantity of water taken from the site of the Croydon Water Works recently occurred on sinking a new well; the total yield of all the wells of Croydon at that time did not exceed $3\frac{1}{2}$ million gallons per day; the supply of water at Croydon Water Works, when sinking the new well, could not be kept up without passing the water pumped from the new well into the old wells for the town supply; thus showing what an intimate connection existed between the wells. He had gauged for 62 consecutive days the volume of water flowing off by the springs at Croydon, in order to ascertain the effect the extra pumping had on the quantity of water flowing off, and he had found that the extra quantity pumped each day corresponded with a diminution in the amount flowing off. The observations which Mr. HOMERSHAM had made, instead of showing the large quantity of water likely to be yielded by the chalk, to his mind showed what a small quantity could be expected from such large areas. The chalk formation was not more than 600 or 700 feet in thickness, and the rainfall of 100 years would fill the chalk from top to bottom. If such a small quantity of water flowed off, what became of the large quantity of rainfall which in the course of the thousands of years during which the chalk formation had existed, had entered that formation?

The fact was, chalk offered a most favourable medium for getting rid of the water. It afforded such a large evaporating surface that the water was evaporated almost as fast as it fell. It was only when the evaporation was at the minimum and the rainfall was at its maximum that any large amount reached the springs. It was perfectly well-known that water flowing underground, obeyed the same laws as water flowing on the surface. It was, therefore,

absurd to attempt to get water, as was repeatedly done, by sinking wells on the tops of hills where the strata and the water fell from them ; it was like a man attempting to catch water at the ridge of his house instead of at the eaves. Underground water was always on the move, as Mr. CLUTTERBUCK had pointed out, and there was not that large amount of water in the chalk formation which many persons supposed it contained. The rainfall was absorbed, but it was not retained so as to be made available, as was clearly shown by the gaugings, which gave the absolute quantities yielded by a given area.

He would like to mention one point with regard to dew ponds. It had been his intention to make some experiments on them, but he had not hitherto found the time. He did not know one of these dew ponds which had not a certain drainage area to it. Their water supply appeared to him to be derived, at least in part, from the drainage area contributing to them. He had observed a curious effect in North Wales, in the autumn of 1875 and the beginning of 1876, in reference to a lake, 2,000 feet above the level of the sea. On several occasions the water in the lake appeared to be in direct communication with the clouds, while all around was clear. He could not account for it, nor could he say whether the waters were giving off vapours to the clouds, or the clouds precipitating their contents into the lake. It was well known that a large amount of water fell in the shape of mist on the chalk downs, and the dew ponds were popularly supposed to derive a portion of their water supply from the deposition of dew.

Another point he would refer to with regard to evaporation was that when examining the district of the South Downs with Professor Ansted last week, they observed that the tops of the hills were quite white with snow, but as they descended, the snow got thinner and thinner, and long

before they got to the foot of the hill it had entirely disappeared. That was due to the fact that the specific heat of the air diminished 1° Farenheit for every 183 feet of altitude, and the less heat, the less evaporation at the height where the dew ponds were found : at the same time, the amount of rainfall increased with the height ascended, about 3 per cent for every 100 feet, as had been pointed out by Mr. HAWKESLEY and Mr. SYMONS.

Mr. A. GARRARD (Associate) remarked that he was interested in some land affected by the Bourne, near Caterham. A friend, who had prepared some statistics with reference to the rise and fall of the water on the land in question, was unexpectedly absent, but he was in a position to state a few facts which might be interesting. It was a noticeable circumstance that the Bourne travelled with considerable rapidity towards Caterham, but when it reached to within a short distance of the railway it took five days to travel a distance of 100 yards. It then rose again on the west of the railway, and traversed nearly a mile in less than twenty-four hours. He and his friend were consequently led to believe that, if a clear channel were kept throughout its course, much of the trouble and inconvenience experienced in the neighbourhood of Caterham would be avoided. The water rose from the 17th to the 22nd of January, 1 foot, from the 22nd to the 27th, 4 feet, from the 27th January to the 7th February it rose to its maximum, another 5 feet. Since the latter date it had only diminished 2 feet, but was gradually going down. It would probably not be difficult to remove the present obstructions to the free flow of the water, and he could not help thinking that the required outlay would be worth incurring.

Mr. J. LUCAS, before replying generally, would point

out one or two wells on the map to which he wished to refer in answer to Mr. LATHAM. At HOOPER's India Rubber Works on Mitcham Common, there was a boring which was said to have originally overflowed, but on being deepened to something like 300 or 400 feet, the water fell to some depth below the surface. Again, when the well at the Brewery at Elmer's End was only as deep as the Thanet sand, the water overflowed 4 feet; but on its being carried to the chalk, the water fell 7 feet, and stood 3 feet below the surface. He mentioned these facts in connection with the inferences drawn by Mr. LATHAM as to the existence of a series of faults in the neighbourhood of Croydon. The strata dipped very fast to the north, so that he did not think the fact of having 70 or 80 feet of tertiary strata was sufficient evidence of a fault, nor was absence of water in the chalk.

The opinion of Professor PRESTWICH, that the underground waters followed the same laws as surface waters, was quoted by Mr. LATHAM. He was not quite sure that he correctly understood what was intended to be conveyed by these words. If it meant that the dry valleys indicated the subterranean drainage of the chalk hills, that was certainly not true. The Wandle Basin, on the chalk, had an apparent area of $52\frac{1}{2}$ square miles, as indicated by the dry valleys. There were three sub-divisions, from the largest of which ($43\frac{1}{4}$ square miles) the Croydon springs broke out. These springs (BRAITHWAITE) were discharging 21,246,770 gallons a day while those at Carshalton, representing according to the dry valley basins, an area of only 8 square miles, were running 17,909,910. The fact was, that the body of the percolating water followed the dip, irrespective of ridges and valleys above. There were more fissures under the valleys, and therefore more water flowed beneath them; but when the water rose under the valleys, it rose equally under the ridges. He knew many deep wells in the chalk sunk in

the very beds of dry valleys. In the millstone grit to which Professor ANSTED had referred, a bed of sandstone frequently out-cropped with the same strike and dip for miles together, crossing superficial basins alternately draining in opposite directions across the line of out-crop, yet the water percolating the sandstone flowed entirely in the direction of the dip, except where it overflowed into the basins draining the other way.

The first point he was asked more particularly to reply to was, how the Roman roads and camps were supplied with water. He knew many Roman roads, but it had never occurred to him that there was any particular difficulty on that point. With regard to Roman camps, he did not know how far the question was intended to include camps occupied by the Romans, but not formed by the Romans.

Mr. WOOLLEY suggested ancient earthworks on high elevations.

Mr. LUCAS regarded those as places which one could not expect to find supplied with water, as they were generally the last strongholds of the fugitive.

In the parish of Chessington there was a Roman camp close to the side of a valley, across which its lower end was produced as an artificial dam. This dam, with the camp, was overgrown by bushes. It was broken at one end, but it appeared to have formerly held water for some considerable time, as the bottom of the valley was filled with a kind of silt which resulted from the washings of the London clay.

There was another camp, a mile or two north of Leatherhead, near Patchesham Farm, exactly similar to the one he had last mentioned, but there was an existing pond there. He would not venture so far as to say that the Romans made those ponds, but certain it was that the earthworks were close to the camps.

The section sent by Mr. BRAVENDER passed through the Boxwell spring and the Thames head, and he told them (but he did not tell them how he knew it) that the water flowing out of the Boxwell spring came out of the Fuller's earth. He would suggest that the temperature of that water would be a very fair test as to whether it did or did not come from the Fuller's earth. If it did, it would be found to be much warmer than the surface water.

It was quite true, as Mr. HOMERSHAM had said, that the surface of the ground might be broken up by frost. He had not mentioned that circumstance, because he thought it was hardly within the limits of the subject. Mr. HOMERSHAM had taken exception to his saying that "the prime indicator of the presence of subterranean water was a spring." Following up the principle that springs meant water at a higher level in the rock from which they flowed, any one ascending the chalk hills from Carshalton springs would conclude that there was water in the chalk hills that fed those springs. He thought that would be a logical conclusion.

He had been asked by Mr. GRANTHAM to explain what he meant by saying with regard to land draining, that the onus of adding unduly to the volume of the floods rested upon the land drainers. He did not wish that, in any sense, to be taken as a criticism on the existing system of land drainage, for that would be absurd. Draining was a proper and necessary thing, and could not be done without: what he particularly wished to direct attention to, was the absence of any counter-measures for the storage of the water taken out of the soil. Having in view the possibility of turning this flood water into some of the absorbent strata, he was sure it might be done by the dumb well system on a larger scale. It was said by Mr. HOMERSHAM that three generations in one family had gained their livelihood by con-

structing dumb wells. He was very glad to hear it, as it was a system, which, with proper precautions, might be made very useful indeed.

He would point out what the hydrogeological question of floods really was. In the chalk and other absorbent strata, as Mr. HOMERSHAM had very well shown, there were no floods, because the equivalent of the excessive rain which, on clays, went to form floods, sank into them. Those absorbent strata were sometimes occupied to a much greater extent than at other times, and there was no reason why they should not be kept charged to the maximum limit. That was one view. The other view was as to surface storage. He often felt concerned, in passing over country, at the neglect of natural sites for reservoirs—not large reservoirs necessarily, but very good retarding mediums for the downward flow of flood waters, and he thought they ought to be turned into reservoirs. He was of opinion that floods could not be stored by gigantic reservoirs in the main valleys, but by a series of dams constructed (on a comprehensive system and with regard to all the interests involved), on sites in the tributary valleys, such as he had indicated in the Paper.

When a flood had reached the proportions to which it had attained by the time it arrived at Kingston, it was impossible to deal with it. If not dealt with when it was little, it could never be handled. Facilities existed all over the country for dealing with the floods before they became heavy. Floods did not originate at low levels; the rain that formed them fell chiefly on high ground and ought to be retarded in its descent to the low levels. Having regard to the scope of the subject in all its bearings, he felt sure that the Government investigation must resolve itself into a Hydrogeological survey, and that nothing short of it would answer the purpose in view.

He begged to express his obligations to the Council of the Institution and to the gentlemen who had so kindly spoken and listened with so much patience to his Paper.

THE PRESIDENT, on behalf of the Council and the Members generally, had much pleasure in conveying to Mr. LUCAS an expression of their thanks for the excellent Paper which he had prepared, and which had given rise to such an interesting discussion. The Members were also indebted to those gentlemen who had attended the Meeting as visitors only, but who had contributed information of great practical value and interest.

The Meeting then adjourned.

REFERENCE TO THE GEOLOGICAL SECTION

TAKEN BY MR. HOMERSHAM.

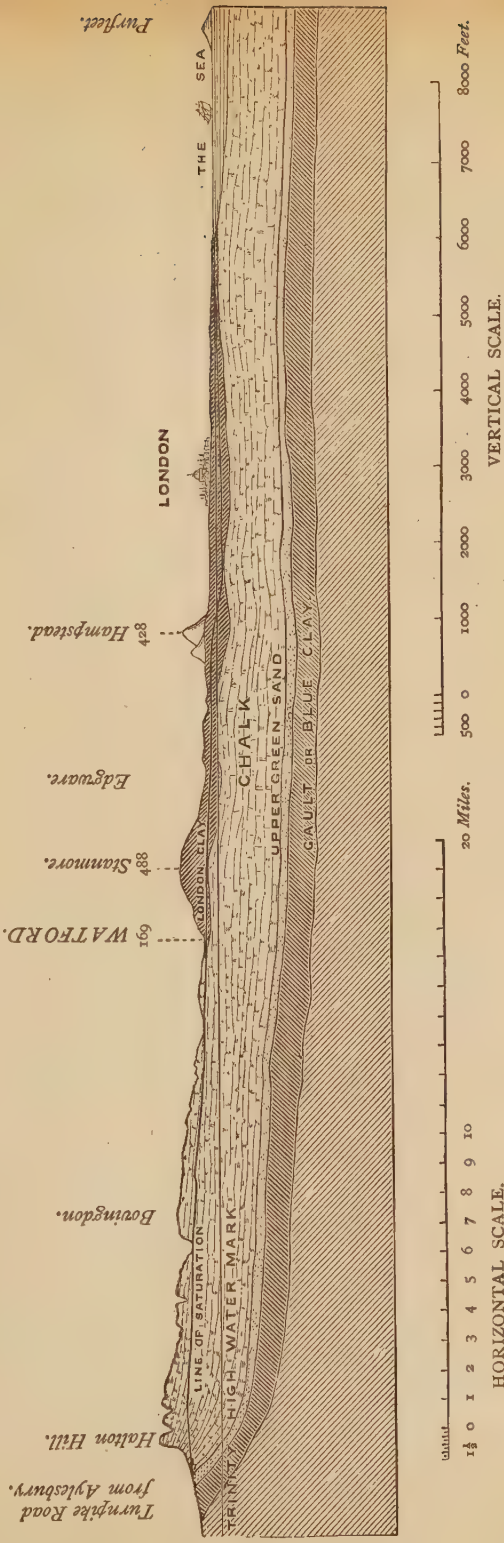
(Referred to on page 222.)

The section shows by scale the levels of the surface of the subterranean water in the chalk formation along the course of the section.

The section has been accurately plotted from surveys and levels expressly taken over the surface of the country, and the varying heights of the subterranean water have been obtained by measuring the water-levels in numerous wells along and near to the section.

The figures on the section show the heights above Trinity high watermark, which is 12 feet 6 inches above Ordnance datum, or mean level of the sea.

SECTION THROUGH THE CHILTERN RIDGE, WATFORD, STANMORE, LONDON, AND THE RIVER THAMES TO THE SEA.



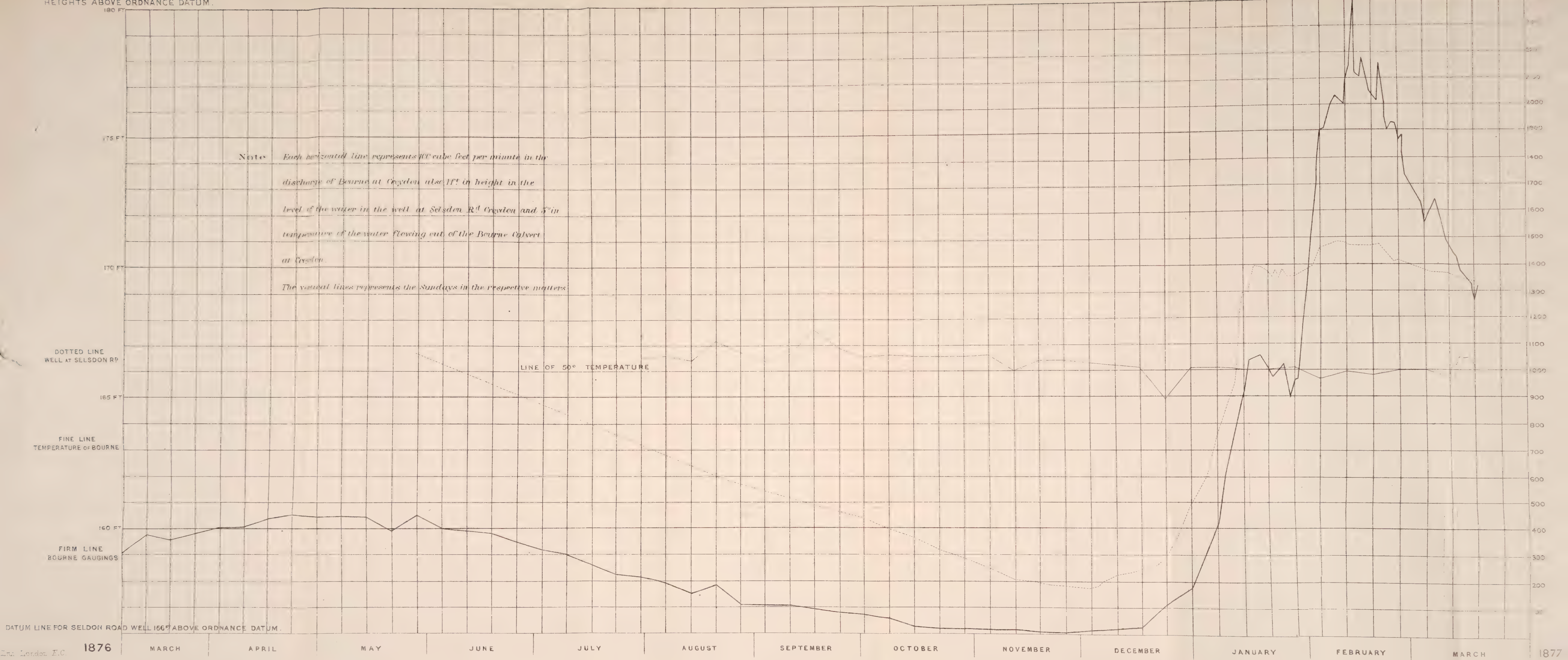
Purbeck.

GAUGINGS AT CROYDON.

DIAGRAM TO ILLUSTRATE MR BALDWIN LATHAMS REMARKS ON MR LUCASS' PAPER.

HEIGHTS ABOVE ORDNANCE DATUM.

CUBIC FEET OF DISCHARGE
PER MINUTE



THE
RIVERS POLLUTION PREVENTION
ACT, 1876.

By JOHN SHAW (MEMBER).

*Read at the Ordinary General Meeting of the INSTITUTION OF SURVEYORS,
April 16th, 1877.*

THE PRESIDENT IN THE CHAIR.

AN old proverb says that "Water is Wealth;" and, it may be also truly said that "Good Water is necessary for Good Health."

The purification of the rivers and streams of this Kingdom is therefore a question of the utmost importance to all classes of the community.

A great deal has been said and written upon the pollution of rivers, and upon the purification and utilization of sewage; and, in venturing to introduce a discussion upon the "Rivers Pollution Prevention Act, 1876," I feel that I have undertaken a very difficult subject, and one upon which many members of this Institution are far better qualified to speak than myself.

As, however, it will be necessary very shortly to deal with the Act of last Session, I shall endeavour to bring before the Institution, as concisely as I can, an analysis of the Act, and the views I entertain upon the practical application and working of it; and, at the same time, venture to call attention to any amendment which may suggest itself.

The impurities, which unfortunately exist at the present time in many of the finest and most beautiful streams of the Kingdom, and the fruitful sources of litigation which arise between riparian proprietors and local authorities, are well known and admitted by all.

The Reports of the Royal Commissioners, and other published reports, have described the great sources of pollution, which are found in nearly all the rivers and streams of the country, and have disclosed the vast amount of mischief arising therefrom; but very little attention appears to have been paid to the consideration of the interference of the flow of water caused by mill dams and weirs, and by other obstructions, which are also productive of much evil.

It has been observed by a practical authority that "The sluggish rivers of the Midland and Southern counties are usually full to the banks or nearly so, and converted into a series of ponds, mill dams, and weirs," and that "If all the rivers in England were surveyed from the sea to their source, the mills upon them valued, and the benefit of their removal ascertained, it would be a measure of national economy to buy them up."

And an old writer of the 17th century says, "A strait water course cut a considerable depth in a thousand parts of this Nation, would be more advantageous than we are aware of."

What was true in 1652, is to a great extent equally true in 1877.

Before entering upon the Act in question, it may be well to notice some of the other powers and rights, which exist for the prevention of the pollution of rivers; and, in doing so I may refer to a recent discussion in this Institution upon "Riparian Rights," which was ably introduced by a learned Associate. It is there said that "Every

riparian owner in virtue of his ownership of the moiety of the soil of the stream is entitled to the use of the water flowing in the stream," and that "Each owner has a natural right to have the stream flow in its natural state, uninterruptedly, without any alteration or diminution in any of the qualities making up its character—that is, in its level, quantity, or purity."

It has been held that, if the water in a stream be polluted so as to occasion damage in law, though not in fact, a riparian proprietor has a good cause of action, unless a right by long enjoyment or grant has been gained. It has also been held that a local authority may be restrained by injunction from causing or permitting any sewage to flow into a stream, and from polluting or injuring the stream, so as to kill the fish, or otherwise to cause a nuisance. Numerous other injunctions have, as is well known, been obtained to restrain public authorities from turning sewage into a stream, either prohibiting them altogether, or on certain conditions.

The Public Health Acts, which are now generally consolidated in the Act of 1875, provide that nothing "shall authorize any local authority to make or use any sewer, drain, or outfall for the purpose of conveying sewage or filthy water into any natural stream or watercourse, or into any canal, pond, or lake, until such sewage or filthy water is freed from all excrementitious or other foul or noxious matter, such as would affect or detoriate the purity and quality of the water." A heavy fine is also imposed upon any person causing or suffering any stream to be fouled by gas manufacture; and, proceedings can be taken by any local authority, for the purpose of protecting any watercourse within their jurisdiction.

The Land Drainage Act, 1861 (which is only voluntary in its primary application) provides for the appointment of

Commissioners of Sewers, with districts or drainage areas to each, and (where in operation) it expressly enacts that, except where any person has any legal right, "No person shall, without consent of the Commissioners, cause any filthy or unwholesome water, or washings of manufactories or mines, or other foul or poisonous liquid to flow into any watercourse within the jurisdiction of the Commissioners,"

Although all these and other powers are well known and understood, the application of the Law has hitherto been found expensive and generally unsatisfactory : hence the necessity for further legislative action, which after the failure of the Bills introduced into Parliament in 1873 and 1875, has resulted in the "RIVERS POLLUTION PREVENTION ACT of 1876."

The Act of last year may be cited for all purposes as the "Rivers Pollution Prevention Act, 1876," and its preamble states that "it is expedient to make further provision for the prevention of the pollution of rivers, and in particular to prevent the establishment of new sources of pollution."

It is divided into six parts, viz. :—

- Part I.—The Law, as to Solid Matters.
- „ II.—Law as to Sewage Pollutions.
- „ III.—Law as to Manufacturing and Mining Pollutions.
- „ IV.—Administration of Law.
 - (1) Legal Proceedings.
 - (2) Saving Clauses.
 - (3) Definitions.
- „ V. & VI.—Application of the Act to Scotland and Ireland.

PART I.

LAW AS TO SOLID MATTERS.

By Section 2—"Every person who puts or causes to be put, or to fall, or knowingly permits to be put, or to fall, or to be carried into any stream, so as either singly or in combination with other similar acts of the same or any other person, to interfere with its due flow or to pollute its waters, the solid refuse of any manufactory, manufacturing process or quarry, or any rubbish or cinders, or any other waste, or any putrid solid matter, shall be deemed to have committed an offence against this Act."

"In proving interference with the due flow of any stream, or in proving the pollution of any stream, evidence may be given of repeated acts which together cause such interference or pollution, although each act, taken by itself, may not be sufficient for that purpose."

It is presumed that the latter paragraph applies to the second and third parts of the Act as well as to the first, as there are no restrictions in the application of the words to this particular section.

In applying this section as to the interference with the due or natural flow of a stream, the saving rights of impounding water under section 17 must of course be borne in mind; and a question may arise, whether the natural or original flow, without any impediment, shall be taken as the basis of action, or the flow as it may be affected by the exercise of any prescriptive or other rights.

The practical answer appears to be the latter, as although it will be desirable to attain the best natural flow, this cannot be accomplished, in many cases, without compensation for existing rights, and there is no provision in the Act for that purpose.

PART II.

LAW AS TO SEWAGE POLLUTIONS.

By Section 3—"Every person who causes to fall or flow or knowingly permits to fall or flow or to be carried into any stream any solid or liquid sewage matter shall (subject as in this Act mentioned) be deemed to have committed an offence against this Act."

"Where sewage is carried into any stream along a channel used, constructed, or in process of construction at the date of the passing of this Act, for the purpose of conveying such sewage matter, the person causing or knowingly permitting the sewage matter so to fall or flow or to be carried shall not be deemed to have committed an offence against this Act, if he shows to the satisfaction of the Court having cognizance of the case that he is using the best practical and available means to render harmless the sewage matter so falling or flowing or carried into the stream."

"The Local Government Board may, by order, declare that this section shall not, so far as regards the discharge of sewage matter by such channel, be in operation until the expiration of a period to be limited in the order."

This part of the Act is very important, as it directly deals with all sewage matter—whether solid or liquid—and makes it an offence, under any circumstances, to knowingly permit any sewage to flow or to be carried into a stream; but the exception in the case of existing works seems only fair and reasonable, as without it many of the great sewage schemes of the country would have been seriously interfered with before any remedial measures could possibly have been taken.

In dealing with an offence under the Act (in Section 10) the Court having power to make an order to restrain offences

may remit to "skilled parties" as to the "best practicable and available means" to be adopted, and may make an order accordingly. A certificate of a Local Government Inspector can be obtained under section 12, subject to a power of appeal to the Local Government Board.

PART III.

LAW AS TO MANUFACTURING AND MINING POLLUTIONS.

By Section 4—"Every person who causes to fall or knowingly permits to flow or fall or to be carried into any stream, any poisonous, noxious, or polluting liquid proceeding from any factory or manufacturing process shall (subject as in this Act mentioned) be deemed to have committed an offence against this Act."

Where such liquid is carried along a channel used, or in process of construction at the date of the passing of the Act, it shall not be deemed an offence if it be shown that the "best practicable and reasonably available means" are being used to render the same harmless.

The same powers and remedies are provided in this section as in the case of Part II., section 3, except as to the latter part thereof; but there are special restrictions in the proceedings which apply only to this part of the Act.

By section 5—"Every person who causes to fall or flow or knowingly permits to fall or flow or to be carried into any stream any solid matter from any mine in such quantities as to prejudicially interfere with its due flow, or any poisonous, noxious, or polluting solid or liquid matter proceeding from any mine other than water in the same condition as that in which it has been drained or raised from such mine, shall be deemed to have committed an offence against this Act, unless in the case of poisonous, noxious, or polluting matter, he shows to the satisfaction of

the Court having cognizance of the case, that he is using the best practicable and reasonably available means to render harmless the poisonous, noxious, or polluting matter so falling or flowing or carried into the stream."

It is important to notice that there is here a distinct prohibition as to any solid matter which may prejudicially interfere with the flow of any stream; but, in the case of any solid or liquid matter which may pollute a stream, there is an exception where the water is in the same condition as that in which it has been raised from the mine, and where it can be shown that the best practicable and available means for rendering it harmless are being used.

The restrictions under Section 6 as to manufactories and mines are important. No proceedings are to be taken under Part III. of the Act save by a sanitary authority, nor without the consent of the Local Government Board. And that Board is to have regard to the industrial interests involved, and the circumstances and requirements of the locality; and there is also an express injunction that the Local Government Board shall not give consent to proceedings in any district which is the seat of any manufacturing industry, unless satisfied, after due inquiry, that means for rendering harmless the polluting liquids, are "reasonably practicable and available," and that no material injury will be inflicted by such proceedings on the interest of such industry.

PART IV.

ADMINISTRATION OF LAW.

Section 7 enacts that—"Every sanitary or other local authority having sewers under their control shall give facilities for enabling manufacturers within their district to carry the liquids proceeding from their factories or manufacturing processes into such sewers."

But this "shall not extend to compel any authority to admit into their sewers any liquid which would prejudicially affect such sewers, or be injurious in a sanitary point of view."

"Nor shall any "sanitary authority be required to give such facilities where the sewers of such authority are only sufficient for the requirements of their district."

The powers thus given appear to be right and proper, and the exceptions named are only reasonable, but at the same time there is some vagueness and uncertainty in the section; as, on the one hand, it is stated that the authorities shall give facilities to manufacturers within their district, and on the other it is particularly expressed that, where the sewers are only sufficient for the requirements of the district, the authority shall not be required to give such facilities.

I presume the intention is that, where the sewers are only sufficient for the ordinary sewage of the district, then the local authority shall not be required to allow their use; but the requirements of a district must clearly include all drainage and sewage which it is necessary to remove from such district.

The 8th section is an important one, as it not only gives full powers to any sanitary authority to enforce the provisions of the Act against the interference with the due flow or the pollution of any stream within, through, or by any part of their district, and provides for the expenses of such proceedings; but it also enables any proceedings to be instituted by any person aggrieved, subject in either case to the restrictions in the Act in sections 6 and 13. At the same time, there is no provision for putting the authority into motion.

Section 9 gives to the Lee Conservancy Board (to the exclusion of any other authority within the area of their jurisdiction) the powers for enforcing the provisions of this Act.

The Lee Conservancy Act, 1868, although only applying locally, is a most important Act, providing for "the preservation of the purity of the water of the Lee and its tributaries by a representative Conservancy Board.

LEGAL PROCEEDINGS.

By section 10, the County Court may by summary order require any person to abstain from the commission of any offence against the Act, or may require any duty to be performed as in such order may be specified.

The Court may also, previous to granting such order, if it think fit, remit to "skilled parties" to report upon the "best practicable and available means," and the nature and cost of the works required, who shall in all cases take into consideration the reasonableness of the expense involved in their report; and any person making default in complying with any requirement of an order of a County Court made in pursuance of this section, shall be liable to certain penalties as therein specified. And Section 11 provides for an appeal from the decision of the County Court to the High Court of Justice, and also provides that, by leave of any judge of the said High Court, if it appear to such judge desirable in the interests of justice, such case shall be, in the first instance, tried in the High Court of Justice.

According to these sections, it appears that proceedings under the Act must in all cases be first taken in the County Court.

Section 12 provides that a certificate of an inspector of the Local Government Board, that the means used for rendering harmless any sewage matter or poisonous or polluting solid or liquid matter, are the best or only practicable and available means under the circumstances of the particular case shall in all cases and in all proceedings under the Act, be conclusive evidence of the fact; but any

person aggrieved by the granting or withholding of such certificate may appeal to the Local Government Board.

The certificate here provided for, is also to be taken as evidence in other proceedings, not under the Act. (See Section 16.)

Section 13 restricts proceedings for offences under Parts 2 and 3, sewage and manufacturing and mining pollutions, until the expiration of 12 months after the passing of the Act, viz., August 15th, 1877, and also requires that in all cases two months' written notice shall be given; it further prohibits any proceedings under the Act while other proceedings in relation to any such offence are pending.

And Sections 14 and 15 provide for orders as to costs of enquiries and powers of Local Government Inspectors, as to witnesses and production of papers.

SAVING CLAUSES.

Section 16 expressly provides that the powers given by this Act shall not prejudice or affect any other rights or powers vested in any person or persons by Act of Parliament, law, or custom, but, that all such existing powers shall remain unimpaired. With the exception only that in any proceedings, which may be taken against any person under any such existing powers, the Court before which such proceedings are pending, shall take into consideration any certificate granted to such person under this Act.

Section 17 provides for the saving of rights of impounding and diverting water; and, practically prohibits any interference with such existing rights; and, Sections 18 and 19 provide for the saving of the Rights of the Thames and Lee Conservancy Acts, and other Acts.

It appears unnecessary to notice the remaining Sections, except the provision that the word "polluting" shall not include innocuous discoloration.

I think it will be seen that the intention of the legislature has been to deal chiefly with two distinct classes of pollution, viz. :—

One which arises from ordinary sewerage works, and another which refers to manufacturing processes and mining operations ; the latter affecting a large portion of the industrial population of the country, which, from the amount of capital employed, and the interests involved, requires great care in dealing with. The offences under the Act are clearly set forth, but in each case, and particularly in manufacturing and mining pollutions, careful provision has been made to restrict proceedings within certain limits, and, in fact, to make it very difficult indeed, in manufacturing and mining districts, to prevent the pollution of rivers under the Act.

It is, of course, most important in adopting remedial measures for the preservation of rivers from pollution, to bear in mind that there are two sides to the question, and that the standard of purity in one district need not necessarily be so high as in another. The provision for giving a reasonable time for adopting remedial means is a wise one ; but I think the restrictions on proceedings under Part III. of the Act, as explained in Section 6, require modification. Practically, the Act resolves itself into requiring that the best means of treating sewage, so as to render it as free from impurities, and as little injurious as possible, be adopted, and these means are not to rest upon scientific principles, but to be based upon practice and common-sense, and in accordance with the peculiar circumstances of each locality.

I am of opinion that this is the true test, but how to carry it out is another and a difficult matter.

The pollution of a river by solid matter is comparatively easy to remedy ; but how to get rid of sewage, whether solid

or liquid, and the pollution from manufactories and mines, is, in many instances, still a difficult problem.

Various opinions have existed, and still exist, among eminent chemists, upon the practicability of purifying sewage. I remember being engaged in an important water supply case with the late Dr. LETHEBY, when he said in evidence with reference to sewage, that he had stated "over and over again, as the result of a very large experience in these matters, that sewage running into a stream in the proportion of one part of sewage to twenty of the stream, and going 7 or 8 miles down the stream, is completely destroyed," that "it is oxidized; it is used by vegetation; it is precipitated."

On the other hand, it has been stated by other eminent authorities, that where there has been sewage contamination, it is very difficult, if not almost impossible, to get rid of it, and that there is no river in the United Kingdom long enough to secure the oxidation and destruction of any sewage which may be discharged into it, even at its source.

I cannot, of course, give any scientific opinion as to which of these views is the most correct, but practically, I think it would be difficult to act upon either one or the other.

I do not propose, in considering the Act, to discuss the best means of purifying sewage, or the various systems of sewage farms, land filtration, precipitation, and chemical processes, or the dry earth principle, of which so much has been said by the advocates of each. At the same time it will be necessary to refer to some of them.

The Report of the Committee appointed by the Local Government Board has most exhaustively dealt with the subject, and, as the result of their inquiries, they have, as is well known, concluded: "That the treatment of sewage

(by deposition or by chemicals in tanks) effects a considerable improvement, and when carried to its greatest perfection, may in some cases be accepted.

“That town sewage can best and most cheaply be disposed of and purified by the process of land irrigation, for agricultural purposes, where local conditions are favourable to its application.

“That land irrigation is not practicable in all cases, and therefore other modes of dealing with sewage must be allowed.

“That towns situated on the sea coast, or on tidal estuaries, may be allowed to turn sewage into the sea or estuary below the line of low water, provided no nuisance is caused.”

This Report seems to leave the question pretty much where it was, but it may be concluded that (with few exceptions) where land irrigation can be adopted, it will generally be considered the best practicable means to be used.

Although I have always advocated land irrigation where it could be accomplished, it is well known that in many localities it is practically impossible, and, therefore, other means must be employed. What these means are must, of course, depend upon the circumstances of each district; but in some cases it is possible that a combination of various plans might be advantageous.

I think that, generally, but particularly where land purification cannot be adopted, it will be desirable to have a double system of sewers—one for sewage proper and another for the ordinary washing of streets, stormwater and other drainage. I have in my own experience adopted this plan with advantage.

A short time ago I visited the sewage works at Newcastle-under-Lyne, where there is the lime process in

operation for the Newcastle drainage; and precipitation by chemicals for the Stoke Union Workhouse nearly adjoining. In the former case the effluent water appeared to be more or less lime water, and the river into which it was discharged was much discoloured by it; it was said, however, to answer the purpose of satisfying the owner of the stream. But in the Stoke Union case, the effluent water was perfectly clear, in fact, I have some of it now in my possession, which apparently is as clear as the clearest spring water; it is not, however, free from impurity, but the system answers the purpose for which it is used, viz., to obey an injunction not to pollute the canal running near.

The plan adopted appeared to be very simple—the sewage was collected into two tanks, to one of which when full, chemicals were applied—precipitation immediately commenced, and within five minutes after the application, the water at the top of the tank was quite clear; within an hour the whole of the effluent, 6,000 gallons, was discharged through a bed of charcoal into a drain communicating with the canal.

It was very remarkable that no disagreeable odour could be perceived at all, but this might be attributed, to some extent, to the sewage being dealt with before decomposition could take place.

We all know that in land irrigation it is sometimes difficult to deal with thick sewage, and it has occurred to me that even where land irrigation is possible, when ordinary precipitation or filtration in collecting tanks is not sufficient, some process like that I have just described might, in part at least, be advantageously adopted.

Although, as I have said, I am an advocate for land irrigation, I am one of those who believe that there is something good in other systems.

For instance, I have seen the Dry Earth system, where

independent supervision could be obtained, answer remarkably well. At the present time it is about to be adopted in a new military centre, in my own parish, where I think it will succeed. On the river Derwent, which runs past Derby, there are large mills up the stream, which formerly had privies and water-closets draining into the river, but where now, by the Dry Earth system, almost all pollution is prevented. Of course, in all cases where this system is adopted, independent supervision is absolutely necessary.

By some one or more of the plans referred to it may be possible, in the case of *ordinary* sewage pollution, to decide upon the best practicable and available means to be adopted to render it harmless, according to the circumstances of each locality; but the drainage from some manufactories and mines appears to me to be beset with great difficulties; and I think that land irrigation for agricultural purposes cannot be accepted as the "best practicable and reasonably available means" to render harmless those liquids which are poisonous.

As regards the drainage from coal mines I do not anticipate so much difficulty, except in the case of old workings, which are not now very numerous. In most new sinkings the water is kept back in the shafts by "tubbing," and there is generally but little drainage after the works are completed. But from lead mines it is very difficult to prevent pollution, and I scarcely know what plan could be best adopted.

From an old lead mine on an estate under my management the water escaped, by means of adit levels, comparatively pure for a great number of years; but something less than twenty years ago the works were extended, and extensive pumping-power was put down. This and the washing of lead discharged a stream of what was said to be "foul water" into the river close by; and a small summer resi-

dence having been built upon a plot of land near, the owner complained of the river being polluted, and applied for an injunction. He ultimately succeeded in closing the mine, throwing out of work a considerable number of people, causing great loss, and the final winding-up of the mining company. Various attempts, during the proceedings, were made to purify the water, chiefly by constructing precipitating tanks and by filtration; but, somehow or other, all these plans failed, and the result was as I have described.

The mine referred to was an ordinary lead mine for producing ore and preparing it for sale. In Derbyshire there are also works for the smelting of lead, and these are more difficult to deal with.

In examining one of these works professionally some years ago, I found the condensed fumes washed down from the chimneys, passing into a number of catch pits, and there allowed to deposit; the discharge from those pits was thick water of a milky colour—of course, poisonous—which, after filtering through a large heap of slag and refuse, ultimately found its way into a brook.

This may be accepted as a description of the pollution from such works, and the general treatment of it, but in many cases it would be unsatisfactory.

Of course, under the Act, proceedings can be stopped, if the person offending can show that he has adopted the best practicable and available means to render harmless the sewage or other matter complained of; but, as disputes are sure to arise in many cases as to what is best to be done, it seems desirable, if possible, to arrive at something more definite than this, and if some competent authority could have been provided for *deciding* upon the best practicable and available means, it would, I think, have been desirable.

I think also that, in the case of poisonous liquids from

manufactories or mines, the purification should, if possible, take place upon, or in connection with, the premises where the pollution arises.

There is, I consider, an omission in the Act, in not making provision for dealing with the alteration of weirs and the removal of mills or other artificial or natural obstructions which are frequently found on many rivers to be the cause of much pollution.

I know of various instances of this kind, and only very recently my attention has been called by the local authorities to a nuisance existing on one of the most beautiful streams in the country, where floods arise and deposits of mud are made by the raising of a small weir.

This is done for the purpose of working an old mill, almost in ruins, and let at a nominal rental, which happens to belong to two owners. Fortunately, I have now an opportunity of purchasing the whole interest in the mill, and my client, who is very largely interested in the district, may determine to remove the obstruction; but, otherwise there would have been great difficulty.

It will be remembered that, in the autumn of 1875, very serious floods occurred in the Midland and other counties.

On the Trent and its tributaries great damage was done, not only in the loss of property, but also by large deposits left by the floods, which became a nuisance and the cause of much pollution.

In many cases weirs and other obstructions on the rivers were the chief cause; but in one case in my experience, the mischief arose by the construction of a railway bank, with only two small culverts as outlets for ordinary drainage, and by covering over a watercourse, which together completely blocked up the valley.

The damage to the district, which is a populous one, nearly on a level with the river, was very great indeed, and in the case of the railway company, any further provision for flood water was declined to be made.

Such matters should I think have been dealt with under the Act.

Another important question, second only to the purification of sewage, is the union or combination of districts, or the formation of new districts, for which there is no provision in the Act. I do not think it will be possible to deal with all the questions of river pollution under the Act by existing authorities, and the necessity for new districts is becoming daily more apparent.

The difficulties which have arisen in the Thames valley, and the opinions of eminent engineers on the subject, with the report of the Local Government Inspector, are familiar to all.

The discussions in this Institution on the working of the Sanitary Acts show also the desirability of a re-arrangement of districts for sanitary purposes.

The authorities of my own town,—Derby,—are at the present time taking steps for the enlargement of the borough, chiefly on sanitary grounds, and for the purpose of complying with the Rivers Pollution Prevention Act.

The outskirts of the town have been largely increased, particularly in the parish where I reside, and in which by reason of various difficulties, the sanitary arrangements are most imperfect.

A Local Board was formed in an adjoining district, and works of drainage constructed, with filter beds to stop the deposit, the whole of the liquid sewage passing into the river. The various districts are dependent one upon the other for drainage purposes. I am ashamed to say that all

the drainage of Derby passes direct into the river, and it will be necessary to make a main outfall, so as to intercept the sewage of the whole district, and carry it several miles away for the purpose of utilization. I am now enquiring into the matter professionally, and I firmly believe that the work can only be effectually and economically done; and the best practicable and available means for purifying the sewage, be adopted by an enlargement of the district.

It will also, I think, be seen that any proceedings under the Rivers Pollution Prevention Act can be much more easily taken when there is only one authority to deal with. Of course, a good deal may be done in the formation of drainage districts under the Public Health Act of 1875, but it would be much better to have more direct provision. The extent of the various districts should depend upon circumstances. It is desirable not to have them too large; but if a combination of districts could be formed, comprising a river and its tributaries, or a particular watershed or drainage area,—over which a central Board or other authority could be placed—sub-districts or divisions of districts could be formed, with local members for each, and this might be done so as to meet the special requirement of the respective localities.

An important feature in the Act is the procedure in the county court. Very large additional powers have, by recent legislation, been given to these courts, and these powers are greatly increased under the Act.

The provisions to restrain offences by a summary order, and if the Court think fit, to remit to skilled parties to report on the best practicable and available means to be adopted—in any case—should be exercised with great care; as upon the appointment of these “skilled parties” very much of the practical application of the Act will depend.

Of course the proceedings by injunction as heretofore still exist, but it is very important to simplify all these.

A good deal has been done by the Act, but something more comprehensive is wanted, which would practically supersede all other proceedings, and deal with all matters directly or indirectly appertaining to the pollution of rivers; and with the removal of all obstructions affecting the course or due flow of a stream, whether natural or otherwise.

This would necessarily involve questions of compensation for existing rights, but the Lands Clauses Act is available for these, and some of the powers of the Land Drainage Act, the Lee Conservancy Act, or other similar machinery might be advantageously adopted.

I should like to see provided, Conservancy Boards or other independent authorities to put the Act into operation, not merely by adopting legal proceedings and deciding upon the best practicable and available means where necessary, but also by pointing out what is requisite to be done, and by advising Local Authorities how to do it.

If this can be accomplished, and new districts or drainage areas be provided, as I have ventured to indicate, I am of opinion that the "Rivers Pollution Prevention Act of 1876" may be made the basis of settling a very difficult question in a practical manner.

I may observe that since this Paper was written, Her Majesty's Government have taken steps to enquire into the administration of the Act, and the formation of Conservancy Districts, so that we may reasonably hope for an amendment on some of the points referred to.

Mr. F. VIGERS (Member) begged to propose a vote of thanks to Mr. SHAW for his excellent Paper. He was not prepared, without a careful perusal of it, to give expression

to the views which he entertained on the subject—a subject in which he might claim to be personally interested, since he was threatened, at the present time, with the establishment of a Sewage Farm not far from his residence, with an outfall into the river which flowed past his house. It might, consequently, be thought that his opinion was not quite so disinterested as it might be, but he hoped to be able, in the course of the discussion, to express his views on the general question with the impartiality which the widespread importance of the subject demanded.

Mr. A. GARRARD (Associate) had much pleasure in seconding the vote of thanks.

Mr. W. H. MICHAEL (Associate) had listened with interest to Mr. SHAW's Paper, and was disposed to agree with many of his conclusions. He felt, however, that the Paper could hardly be discussed with advantage on the present occasion. He therefore moved that its consideration should be adjourned until the next meeting.

Mr. R. HORSFALL (Member) said that, as he could not be present at the next meeting, he would venture to offer a few remarks on the present occasion. He resided in the manufacturing districts of the West Riding of Yorkshire, and could speak with some experience on the subject of the pollution of rivers. At Wakefield, the supply of water for the town was taken from the river Calder. There were something like half a million of people residing about Wakefield, and all the refuse from the houses, dye works, water closets,—in fact every kind of sewage—was poured into the Calder before it got to Wakefield, and some 40,000 people drank that water.

Mr. MICHAEL, interposing, said that a very large quantity of the water for the town was now taken from the sandstone—in fact, nearly three-fourths of the supply.

Mr. HORSFALL repeated that the whole supply was still drawn from the river Calder. Last session, however, power was obtained to get water elsewhere; but at the present moment the facts were as he had stated.

Mr. MICHAEL replied that he spoke from intimate knowledge, seeing that he was counsel in the case before Parliament; and he maintained that, at the present time, a large quantity of the water at Wakefield was obtained from the sandstone.

Mr. HORSFALL replied that, if that were so, the change had been very recently effected.

At the town of Newcastle-under-Lyne, towards the end of last year, a process of chemical purification was adopted. He had just received from the North of England some samples of foul water, of effluent, and of the residuum, which he had brought with him for the inspection of the Meeting. It was a sample of sewage from dye works, dealt with in the same manner as the sewage of Newcastle-under-Lyne. In one sample of the residuum, the wool and particles of flock could be seen; and he had been told by an analyst that a profit could be made from dealing with that sewage, on account of the large quantity of grease and flock which it contained. These ingredients were very rarely found in so large a quantity in sewage water.

Mr. E. RYDE (Vice-President) ventured to draw the attention of the Meeting to what seemed to him to be a

peculiarity in the Act, viz., that under it, all proceedings can be stopped if the person offending can show that he has adopted the best practicable and available means to render harmless the sewage or other matter complained of.

He wished to direct particular attention to this special feature of the Act, and to suggest to those Members who were going to discuss it, that this principle seemed to prevail throughout the whole Act. The provision which gave to the County Court power to call in some skilled authority to say what should be done, was one in the efficacy of which he had no confidence.

Mr. J. COLLINS (Visitor) would be glad to submit to the Meeting some facts with reference to the mode of sewage treatment adopted in the town of Bolton, in Lancashire, where he lived. Some six years ago, an injunction was obtained against the Corporation of Bolton, who, at that time, were making a very foul sewer of the river Croal, which ran through it. Attention was directed to the operations of the Native Guano Company, which treated with the Corporation, and works were built which were intended to deal with the sewage of some 90,000 people. Representations, however, were unfortunately made that this could be done with a profit; and this was one of the first delusions of which people had to disabuse their minds; for an ordinary sewage (he hoped Mr. Horsfall's sample represented an extraordinary one), capable of yielding a profit to the operator, had yet to be found. It was said that the Corporation of Bolton would realize some £4 a ton on this guano, (as it was called,) which was to be recovered from the sewage of the town. It was tried, and failed. Other experiments were entered upon, and the Corporation of Bolton invited anybody to operate on the sewage at their disposal; the result being

that the Corporation adopted a process patented in 1873, by Messrs. Marsden and Collins, which is now carried out in the operations of the "Utilization and Clarification of Sewage Company, Limited," Leeds. They were now treating the sewage, as appeared from a return which he held in his hand. The cost was such that it was reported upon as being the most economical of all the processes of precipitation tried hitherto—that was to say, for the general purposes of clarifying the sewage of a manufacturing town such as he had named. At this point it should be mentioned that no one system of treatment could be adapted to every town. In some, water-closets would be found to form the principal sources of contamination; in others, the operations connected with the woollen trades and large dye-works. The town of Bolton contained dye-works, printing-works, iron foundries, tanneries, and so forth; and it therefore seemed to him to be a very fair sample of a town suitable for testing the value of a process. Some time since, the Corporation of Bolton determined to ascertain the value of the work they were doing, and, unknown to any of the officials connected with the sewage works (and he, Mr. Collins, would take the opportunity of saying that he was not officially connected therewith), took samples and submitted them to Dr. Voelcker, the chemist to the Royal Agricultural Society, &c. In his report he said: "The effluent water is clear, almost colourless, and free from any decidedly disagreeable smell. It has only a faint smell, scarcely reminding one of its origin. In my opinion, effluent sewage, purified as efficiently as the sample analyzed by me, may be safely discharged into a watercourse without creating any nuisance. The effluent which you sent me is one of the most successfully-purified samples of sewage which has ever come under my notice."

That was certainly a considerable meed of praise, and was, so far, satisfactory ; and, though the effluent still contained elements which would make him hesitate before he recommended it to his friends for drinking purposes, it would possibly satisfy the requirements of the Rivers Pollution Commission. Taken together, the result of the clarification and the cost of its performance should give data by which to judge of the success or non-success of sewage treatment. It was not possible for any treatment to claim the power of absolute purification, so much depending on circumstances,—the locality, and other considerations. Were it possible that two or more of those processes could be combined—such as irrigation with precipitation—a complete clarification process, as far as it was possible to obtain it, would be secured. A word or two as to the oxidation of sewage water in streams. In the Irwell and Mersey they had a gigantic nuisance. High up, by the town of Bury, this nuisance began. The Irwell was fouled before it was many miles from its source (it picked up various streams in its course, some thirty or forty miles, to the Mersey), and he could only say that, during a summer day especially, it was not the most delightful thing to make the old-fashioned journey from Manchester to Liverpool by boat, for constant bubbles of gas, the result of the decomposition of organic matter, kept rising to the surface at every point of the journey. A proof that this oxidation had not taken place, was seen in the mud flats, as they had been properly termed, formed by deposits of sewage matter, and it was said that, in the reaches of the Mersey, places which formerly yielded large quantities of shell and other fish no longer did so, owing, no doubt, to the large quantity of sewage coming down from the towns higher up

the stream. The foul water coming down was met by the tidal wave coming up, and a subsidence of solids took place at these points, and it was found that the banks thus formed were aggregating more and more every year. The practical remedy was to attack the evil at its source, and in his neighbourhood some of the large manufacturers, dyers, printers, and bleachers, were engaged in treating their effluent before they turned it into the stream, not considering it right to create a gigantic nuisance for their neighbours lower down.

One large firm of calico printers in Lancashire, using a large amount of soap in their processes, the greater part of which would, in the ordinary course of things, pass away from the works into the river, now collected it in reservoirs, and recovered the fat and sold it. This was done also in his own neighbourhood, where large quantities of soap were made; and he was told that the recovery of what would otherwise be wasted, not only repaid the outlay, but left a margin for profit.

The effects of the discharge of poisonous matters into rivers were exemplified in a striking manner by the River Ribble, a stream very much frequented by Lancashire fishers. From time to time, it was discovered that the fish were seized with a sudden mortality, and hundredweights of them were taken from the banks in the course of one night. An investigation revealed the fact that they were poisoned from the solid matter said to be scoured out from the print works higher up the stream. In the old times, cow dung was used in the calico printing works, but its place was now more economically supplied by arsenite of soda, which passed off into the neighbouring reservoirs, and thence into the river, and poisoned the fish. There was no more difficulty in

dealing successfully with this pollution than with the water from dye-works. It was simply a question of ways and means. It should be borne in mind that this was an evil of such gigantic and gradual growth, that the application of a remedy could hardly be followed by an immediate result, for important interests were at stake, and could not be interfered with to their damage. Therefore, whatever means were adopted, they should be available to the manufacturer, and easily at his hand, and in the course which was being taken, as he before suggested, more particularly as a chemist, by treating the matters with chemical re-agents, he believed they had effected something, and would in time effect still more in the desired direction.

THE PRESIDENT said that, before adjourning, he should like to call attention to an illustration in Mr. SHAW's Paper which tended very much to confirm the concluding observations of their friend, Mr. COLLINS, as to the care which it would be necessary to bestow on the settlement of any absolute course of action as regards industries; the necessity for which constituted the justification of the guarded directions throughout the Act now under consideration. Mr. SHAW instanced a case of an old lead mine, from which the water was discharged into a stream, and a small summer residence having been built upon a plot of land near it, the owner complained of the river being polluted, and applied for an injunction. The complainant ultimately succeeded in closing the mine, throwing out of work a considerable number of people, causing great loss, and the final winding-up of the Mining Company. Now, it was certainly open to argument whether such action was favourable or unfavourable to the public interests, viewed as

a whole. The small house was, undoubtedly, preserved unimpaired. On the other hand, a considerable number of people were thrown out of work, thereby causing great loss, and finally the winding up of the Company. If that action were to be extended over all our manufacturing districts in the north of England, it would become a very serious question indeed how far it would not be more advisable to continue the existing state of things, than to extinguish several principal trades; and therefore, under this Act, it was provided that it was to be operative only where the person causing the injury was not taking all the means in his power to reduce the injury to its smallest possible degree. That, he thought, was the justification of the guarded directions in the Act, and in the present discussion both sides of this subject must be regarded, as well as many other considerations.

The amount of rain-water falling upon the Penine Chain would suffice, by storage, for the provision of water for the great manufacturing towns on both sides of it. It had long been ascertained by experience that the magnesian limestone cavities hold sufficient water for the Durham towns. The new red sandstone is a water-bearing stratum, and would supply any quantity; while the chalk is regarded as inexhaustible of water if penetrated to the green-sand. Rivers might, or might not, have been made to feed canals, but certainly need not supply drinking water to large populations. It is an accepted fact that all sewerage should be diverted from the rivers, the only question being the best mode; so that the cessation of the industrial impurities is really the chief object now to be secured. The Act under discussion enables this object to be attained so far as is consistent with the continuance of the industry; and where no

middle course is possible, Parliament may decide hereafter upon the facts collected under the provisions of this statute.

The vote of thanks having been carried unanimously, on the motion of Mr. MICHAEL, the discussion was then adjourned.

AT
THE ORDINARY GENERAL MEETING,

Held on Monday, April 30th, 1877.

THE PRESIDENT IN THE CHAIR.

The discussion on the Paper read by Mr. J. SHAW, at the last Meeting, on "The Rivers Pollution Prevention Act, 1876," was resumed by—

Mr. W. H. MICHAEL (Associate), who said that, before the provisions of an Act of Parliament could be profitably discussed, it was necessary to have a very clear idea of the object sought to be accomplished by the Act, and not only that, but of what it ought to accomplish. Now, he regarded this Act as a tentative one, passed for the express purpose of being amended, for in its present state it was almost inoperative, and he believed that its promoters were extremely wise in giving it this character. It might be asserted as a general principle that legislation, more especially legislation of a compulsory character—and it ought always to be compulsory—if much in advance of popular opinion, became practically inoperative. That this was so, could be seen in numberless instances, and in no case more strongly than where sanitary legislation was imposed on the public before they were prepared to carry out its various enactments. The truth of this had been displayed in connection with gas supply, water supply, and the various sanitary matters dealt with in the first Sanitary Acts, when a Board of Health of a very active character

endeavoured to enforce enactments on a public who did not believe that the benefits to be conferred by the carrying out of sanitary improvements would compensate for the burden imposed in respect of them.

The remarks with which the President closed the discussion on the last occasion struck him as being very sensible, for they went to the very root of the matter. If the whole thing were *res nova*—if, for the first time, the question were asked, “What ought to be the object of a Rivers Pollution Act?” the reply would assuredly be, “To keep rivers free from pollution.” When, however, questions of this kind came to be examined more closely, it would be found that they were not susceptible of such simple treatment. The rivers had been allowed to become great sewers and receptacles for every species of manufacturing refuse. The evil, be it remembered, had grown up with public assent and consent, and any abrupt attempt, such as had been advocated by ardent sanitarians, to define in absolute terms the precise amount of pollution to be permitted to towns or manufacturers would, in the present state of the public mind, tend not only to the failure of any Act, but to its actual repeal, so desperate would be the consequences which would follow the attempt to enforce its provisions. The authors of the Act had therefore proceeded, as it seemed to him, tentatively—passing a moderate measure to begin with, and waiting until time revealed its defects before proceeding, by gradual steps, to prepare amending Acts which should more nearly meet the requirements of the case. Meanwhile the public mind was being educated—a fact which would tend both to the prevention of the further pollution of rivers, and to the removal of already existing evils.

Now, it should be remembered, as he had before observed, that there had grown up in this country prescriptive rights

of pollution. Mills and manufactories had been suffered to be erected on the course of streams, and rights had been acquired with respect to the user of the water, which, though not defensible on grounds of public convenience were nevertheless of a perfectly legal character. The owners of these mills and manufactories had as much right, for certain purposes, to use the water in their operations, as the riparian owners on the banks of the stream. In view of this fact, the Act followed the principle observed in the framing of the Public Health Acts—namely, that while it was extremely desirable that certain bye-laws should be enacted for the construction of houses so as to insure ventilation and absence of nuisance from sewage, &c., those enactments should not apply to houses erected before the constitution of the districts formed under the Acts. In no other way could the Sanitary Act and the Public Health Act of 1875 have been enforced.

One great feature in the Public Health Act of 1875 was the power given to the Sanitary Commissioners to proceed against a nuisance, whether rural or urban, created and existing outside their district. Before the passing of the Act of 1875 there was no such power, and, therefore, it constantly happened that a local Board district, or borough, was in the worst possible sanitary condition, owing to causes which arose outside its bounds. The existence of this same power in the Rivers Pollution Act was a very valuable feature, so far as it went. There was, however, one great defect in the measure, as Mr. Shaw had pointed out—namely, the absence of any conservancy authority to supersede the present fragmentary system of dealing with these matters, something like the county Boards, the desirability of establishing which had lately occupied the attention of Parliament.

For the last three weeks the provisions of a very important Bill—a Borough Extension Bill—had been under discussion in Parliament, and had been very carefully debated.

The inequalities arising from the present boundaries of sanitary districts were, no doubt, familiar to all. As matters now stood, and this applied particularly to manufacturing districts, where many burdens were imposed in the form of borough rates, persons desirous of the advantages of the borough availed themselves of land immediately outside the boundary for building mills and manufactories, or long rows of houses. These persons not only escaped payment of the borough rates, but, being outside the urban sanitary district, polluted with impunity the streams which, in many instances, formed the boundary. It sometimes happened, moreover, that the various streams ran into the river which passed through the borough, and which were more or less polluted by persons outside its limits. It was quite true that under the Rivers Pollution Act, power was given to the urban sanitary authority to take proceedings in order to prevent the creation of a nuisance by pollution, but the difficulty was that the Act entailed proceedings which involved an amount of quarrelling between neighbours, from which they would shrink, instead of constituting one central watershed authority, in which could be vested the whole of the water jurisdiction of a large district, and enabling that authority to deal with it in such a manner as would preserve all rights and secure uniformity of action.

Another Bill had recently been before Parliament, the subject of which was a certain river (he would mention no names) into which a large town poured its sewage. There were several sets of Commissioners down the river for the purpose of constructing sewers to prevent floods, and for other purposes, the river being divided into various districts, and the combination of authorities was such that whenever an attempt was made to do anything, the conflicting rights of the various bodies rendered it impossible to act without their starting up and declaring, "What you propose to do is

beneficial to you as promoters, but it entails ruin on us." Therefore, as Mr. Shaw had pointed out, this state of things, which was frequent, not being recognised, the Act created no efficient power for taking charge of the rivers within a large area. The Government, at last, had recognised this, and had undertaken to give no more opposition to the formation of large county Boards for sanitary purposes. It was a question of finance, and finance was really at the bottom of all sanitary measures. If, therefore, there could be found some comprehensive body, not provided for in this Act, which should grasp the whole matter, he thought the first difficulty would be solved.

He might mention one good provision in the Act as to the merits of which all would be agreed, namely, the provision against solid matters being turned, in future, pell-mell into rivers from the manufactories, a practice from which much evil had arisen. There was the river at a conveniently lower level, and slag, cinders, or ashes, or whatever the refuse might be, was poured into it, and filled up its bed.

There was one great difficulty in the administrative portion of the Act. By Section 6 the local authority was to carry into effect its provisions. It had been argued—and, he acknowledged, with great truth—that the local authority generally consisted of the parties to be proceeded against under the Act. Manufacturers who caused pollution were generally of such local importance as either to be representatives themselves, or connected with the representatives of the district, and therefore the parties interested in the continuance of the nuisance were called upon to take measures against themselves. Nevertheless, it would be fatal to the operation of the Bill (as the President had so well pointed out) to allow even our sanitary requirements to destroy our industries. Due consideration must be had for the trade and manufactures of the country, and it

would not do to proceed, irrespective of consequences, against the whole body of manufacturers. If a nuisance were created which was so great as to force an urban authority or a rural authority to the taking of remedial measures under this Act, those measures would be taken ; and, although it was so faulty, it put a power into the hands of the authority, and that authority might be fairly said to represent the public view and the voice of the district. If the authority failed to carry out the wishes of the district, and the nuisance became intolerable, the inhabitants had the power of turning out the members of the local authority, and returning others who would more faithfully do their duty. While he acknowledged that this procedure was likely to be involved, he thought the promoters of the Act were very wise to give it that form, because, if it were found to fail, it would give the people a powerful pretext for going to Parliament and saying, " You desire that the rivers shall not be polluted, and we thought we could rely on the local authority to take steps to prevent it. Experience, however, has shown that we were mistaken ; and you must now give more stringent powers, and an immensely larger area, taking in the water-shed of the district, so as to remedy what experience has shown to be inefficient." Provision existed in the Act that no proceedings should be maintained against manufacturers who could show that they adopted the best practicable and available means to render harmless the sewage or other offending matter. That, he thought, had the effect of remitting the question to the realms of uncertainty. In any case of water-pollution, however aggravated—even though tons of arsenical liquid were poured into the stream—scientific evidence could be produced to show that it was doing no great harm to the stream, and that the best available means were employed. Still, he thought that the efficiency of the provision should be

tested in practice; and then, if it failed, more stringent protection could be sought.

Mr. W. T. SCARTH (Member) said that he was largely connected with the lead-mining districts of the north of England, and he was quite sure that any measures adopted should be applied with the greatest care. Much had been done lately in the county of Durham by way of preventing noxious water from entering the Tees and the Wear, and rapid progress was being made in carrying out the remedial measures which had been advised. No doubt, to a certain extent, the water which came from the washings of the lead ore was objectionable, but not, in his opinion, to the extent which was generally believed. He feared that, if power were vested in the local authority, there was such a strong prejudice with regard to the refuse from the mines, that injustice might be done to great industries. He quite agreed with Mr. MICHAEL in thinking that some superior authority should be created for investigating the evils complained of, and that they should not be left to the local Sanitary Board.

Mr. W. SHELFORD (Visitor) begged, in the first place, to thank the author of the Paper for having taken, or at all events given the Meeting an opportunity of taking the subject out of the groove of sewage disposal—a question which had agitated the public mind for some time past, and had been discussed “ad nauseam.”

As he (Mr. SHELFORD) happened to be an engineer, it might be useful to refer to the sort of obstructions to the free flow of the water existing at the present time, beginning with the lower end of the river, *i.e.*, the lower end of the fresh water portion. He would take as an illustration the river Thames, where, at the top of the tide-way, was

Teddington Lock. This lock, even when first constructed, was an obstruction, and now, owing to the great improvement which had taken place within the last few years in the tidal action of the Thames, was a greater obstruction than ever. The effect of all such obstructions in tidal rivers was that the matters in suspension in the tide-water were deposited, and the result was that the bottom and sides became covered with mud, and the river, instead of being a fresh, sweet channel, became a stagnant pool. The condition of the river Thames at Richmond, and above that town, was due, no doubt, in a great measure to Teddington Lock, and although he was aware that its removal would interfere with vested interests, and perhaps on that account was not practicable at the present time, yet from an engineer's point of view there was no doubt whatever that the right step to be taken, in order to improve the river Thames at Richmond, and above it, was to remove Teddington Lock. By that means the quantity of tidal water passing Richmond would be about doubled, and the banks and bed of the river would be scoured and cleansed, to the great sanitary improvement of that town and neighbourhood. But he did not wish to confine his observations specially to Teddington Lock. He would remark that there were other locks in the river which obstructed the waterflow. The fall of the river Thames from Lechlade to Teddington was about 2 feet per mile, and the fall of the water had been reduced by these locks to 8 inches per mile. The necessary consequence was that there were floods, and not only so, but each weir formed a pond of stagnant water, which served as a receptacle for any matter which might flow into it. There were other districts he could name where rivers were in a still more neglected and obstructed condition. Sometimes there was a great bed of gravel which towns were built upon, at a

level of a few feet above the river. The consequence of that was that in a time of floods, such as that of the last few months, the water rose, not only over the river's banks, but through the gravel itself into the floors of the houses, and in that way towns had lately been under water for some weeks. This state of things was caused, in one instance that he knew, by mills or dams below the town, which, if abolished, would free the town from floods, and enable it to drain itself into a natural outfall. The tidal condition of rivers had long received the attention of the Government. A great deal of care had been taken of tidal estuaries, but, with few exceptions, fresh water channels had not been attended to at all. The Thames had its Conservancy Board, and so had the Lea, and there were a few others; but the great majority of rivers were entirely neglected. If reliable data, such as plans and sections—and there were many such in private hands—could be obtained, and copies of them deposited in a central office accessible to all persons interested, the carrying out of future improvements would be materially assisted.

One great difficulty with regard to the removal of obstructions lay in the conservative spirit of all our Governments in regard to such measures. What was needed was not the conservation nor even the prohibition of weirs, but their removal, as the first step towards improving the rivers.

A practical difficulty which occurred to him with regard to Conservancy Boards, was the boundary of the districts under their jurisdiction. It had often been suggested that such boundaries should be coterminous with the watershed, which was, no doubt, the natural boundary for districts of the kind, inasmuch as the whole of the watershed must be more or less interested in its natural drain. If, however, any such limit were fixed for sanitary purposes, it would be necessary to make an exception in respect of water supply,

for it was almost general, or, at, all events, very usual, to find that towns were supplied with water, not from the valley or watershed in which they were situated, but from an adjoining one. He might mention one instance where it would be a positive hardship to confine the supply of water to that derived from the watershed area—namely, the valley of the Nene. This river, below Peterborough, passed through fens, which were dry in the summer and inundated in the winter, and the quantity of water coming from Peterborough was quite insufficient to supply the wants of the district in summer. The town of Peterborough was now supplying itself from the watershed or tributary of the Welland, and Wisbeach from the watershed of the Ouse. He was sure that had the water supply of these two towns been limited to the watershed of the Nene, they could hardly have been supplied with water fit to drink.

Mr. C. G. GREY (Member) thought that, in discussing the Act, the President's remarks at the last Meeting that "It enables this object (the cessation of industrial impurities) to be attained so far as is consistent with the continuance of the industry," should be borne in mind. Now, any person who had seen some of the filthy rivers to be met with in the kingdom, and had observed how unnecessarily both solid and diluted matters were thrown into them, must be aware how injurious they must be to health, and must earnestly support any legislation designed to compel those who polluted rivers to abstain from doing so, and to persuade others to find means for preventing that class of pollutions which seemed at present to be unavoidable.

Legislation, however, must not be pushed so far as to stop the great industries of the country. The Act was in some respects more favourable to some industries than the Bill as originally introduced. In the original Bill mines

were included in the first part of the Bill, so that any pollution from lead mines, whether from solid or diluted matter, which rendered the water of the river injurious, could be made the subject of attack by any one, without the protecting intervention of the Local Government Board, given in the case of manufacturing pollutions. It was, therefore, a protection to those industries that proceedings could not vexatiously be taken against them without the action of the local authorities, or, in case of their default, at the instance of the Local Government Board, who, under the 8th Section, could compel them to act, if, after investigation, it should appear to be necessary to do so. In cases where persons had to show that they had used the best practicable and available means for preventing pollution, he thought a great deal might be done under the Act. Means had been discovered for rendering the refuse from many manufacturing processes perfectly harmless, or for excluding such refuse altogether from the rivers, and, where the efficacy of such means had been sufficiently established, other manufacturers carrying on the same process who neglected those means, provided they could be adopted at a reasonable cost, deserved no sympathy if proceedings were taken against them. He had with him particulars of two cases in which preventive means had been successfully applied. The first was a large paper mill on the Tyne, which formerly put into the river a great quantity of acid used for reducing the esparto grass to pulp. This acid killed the fish for some distance down the river whenever it was let off, which was once in twenty-four hours. The process now adopted in this and in most other paper mills was to pump the water into tanks, where it was first heated and then allowed to cool. The precipitate thrown down became, after a time, about the consistency of treacle. It was then roasted, after which the ash was thrown out, and

the residuum became perfectly hard—so hard, that it had to be broken up with picks. It was then used over again, and was as good as ever. Mr. Brown, the proprietor of the mill, assured him that, after a trial of many years, and the most careful calculation of the cost of keeping the kiln in order, he found that he made a slight profit by the process. But, whether there was a profit or not, there was certainly no excuse for others who neglected to adopt the process. No doubt there were certain special facilities in the case he had described (coals were very cheap,) and it would, of course, be open to others to prove that the process was not practicable, owing to the want of this particular advantage.

The other case was that of some large tin mills at Cambridge, where Pughsley's patent was employed, and of which Mr. LESTER, the proprietor, had given him a full description. The process was very simple, and yet was neglected in some tin mills. It appeared that there was a great quantity of sulphuric acid used in preparing the iron sheets for the reception of the tin, and the plates were dipped in a bath of that acid, mixed with sawdust. This compound was formerly permitted to run off into the river, and, as it contained a large quantity of acid and iron, it not only poisoned the fish, but rendered the water unfit to be used for washing or for ordinary domestic purposes. This liquid was now pumped up into large tanks, and allowed to stand until the sawdust settled at the bottom. It was then syphoned off into other tanks, and evaporation was promoted by heat until green crystals were formed, which were removed. After the process had been repeated two or three times a brown fluid was left, which, he was told, was two-thirds of the strength of the original acid, and could therefore be used again, with the addition of fresh acid. That system, again, taking into account the expenses of working it, left a small profit; and, as the quantity of fluid

was not very great, and tin mines were generally within reach of places where coals were comparatively cheap, was not expensive in application.

Where means of the kind for preventing pollution were at hand, the manufacturer who neglected them was not entitled to pity if he came under the lash of the Act. As a matter of law, he presumed that, if the means were efficient, it did not matter whether they were or were not the best available means.

The first part of the Act, which dealt with solid matters, applied to quarries, &c., and very properly so, seeing that the owners of quarries were in the habit of throwing solid refuse, into the rivers. He might remark that there was a difficulty in some cases in keeping solid matters out of the rivers in some of the old mining districts, situated in narrow valleys, where the quantity of refuse was very great and the space was too contracted to allow it to be deposited out of the reach of the floods.

It was also quite impossible in all cases to prevent discoloured water from going into the rivers, and the 20th clause of the Act, provided that discoloration of water should not be considered a breach of the Act, if innocuous. *Apropos* to this, he might instance a stream very much complained of by fishers, and the Salmon Fishery Commissioner, Mr. Frank Buckland, was sent to inspect it, when he assured him that as good trout were to be found in that stream, as in any other part of the country. Mr. Buckland and his friends considered it quite impossible, because a shilling could not be seen at the bottom of a basin containing 6 inches of the water. Mr. Buckland brought a bottle of this water from the north of England to London, and took it with him to a meeting of some friends at his museum, where it was put into a glass bowl, in which he placed some of his pet fish,

and the gentlemen took their watches out to see how soon the fish would die. They did not die, however, but exhibited every sign of undiminished vitality; and both the water and the fish were consigned to the tanks. In this case the water in the river was discoloured, but innocuous. The mud was of a light, soft, description, all the siliceous matter sank to the bottom, and it was not until diluted by admixture with tributary streams that it ceased to affect the river.

Mr. H. ROBINSON (Visitor) observed that the author of the Paper proposed, as the result of his experience, the adoption of a separate system of drainage in towns. With this, however, he could not quite agree. At the present moment, he was draining a town on the principle, as far as possible, of excluding the rain-water from the sewers proper. The practical difficulty was to prevent the street-washings and other refuse—which it was not desirable should be allowed to run into the streams—from finding their way there after floods.

It was very desirable to treat sewage before decomposition set in. Half the difficulty of treating it by irrigation or by chemical processes would be met if this could be accomplished. The author stated also that he was an advocate of irrigation; and so was he (Mr. ROBINSON), where land could be obtained, (which was not often possible) to comply with the requisite conditions of quantity and situation. He did not propose to discuss the hackneyed question of sewage treatment, but he might mention that he had collected information from about thirty-five towns with respect to the treatment of sewage under different systems. That information would be published in the course of a few days. It showed that, where the sewage of a town like Wrexham was purified on land having a favourable elevation, and where

the land was of good quality, some small profit was claimed be made over the cost of working. At Wrexham, however, no allowance was made for the cost of management, the amount of which would depend on the value assigned to the services of those managing.

In the case of Wrexham, if a fair value were put upon the services of Colonel JONES, who was a gentleman of well known intelligence, the small profit claimed would be converted into a loss. At Eton and Crewe the expense which was incurred in treating the sewage on land would represent a heavy burthen on the ratepayers for all time, as it entailed a rate of upwards of 5s. per head of the population.

On the whole, the figures which he had prepared showed that each case must be dealt with according to its special circumstances. Where land could be readily obtained, adopt land, but where it was at a great elevation above the outfall sewer, and much pumping was involved, it should only be adopted as a last resource, and in such cases chemical treatment was a very useful auxiliary. He was himself adopting a combination of the two methods of treatment, in several cases with advantage. Some years ago he expressed the opinion in the course of the discussion of Mr. HOPE's Paper, that the solution of the sewage question would be found in a combination of the two systems—land and chemical treatment, the amount of land available determining the degree to which one or the other should predominate. With sufficient land, the hurtful ingredients could be removed from the sewage and utilized in the soil without the aid of chemical treatment. He did not agree with one of the speakers at the last Meeting (Mr. COLLINS), that the system he referred to at Bolton was the cheapest, as it was only treating one half the sewage for a third of the week and without dealing at all with the sludge. Such

statements ought not in any case to be accepted without a full knowledge of the facts.

Mr. W. G. HARRISON, Q.C. (Associate), believed that the Act would be totally ineffective for dealing with the sewage of districts. It was all very well to say that "every sanitary authority shall have power to enforce," but there was a vast difference between having power to enforce an Act of Parliament, and being obliged to enforce it. What happened in small suburban districts was familiar to every one. It was practically impossible to get ratepayers to act against themselves. What was likely to be the effect of Sections 2 and 3? Absolutely nothing, he believed. The Act, it seemed to him, might even have a bad effect; because whereas, before it was passed, the owners of property felt themselves under some sort of obligation to clear out the streams and keep them pure and fresh, for the advantage of themselves and their tenants, he was inclined to believe that this would no longer be the case, for they would say, "There is the sanitary authority, let them do it."

He observed that a special exception was created in favour of the Lea Conservancy Board. The Lea Conservancy district was a very large one, but what had the Board done? Why nothing at all, and he very much doubted whether they ever would do anything. An authority had been set up which might act, but he believed would not act; and until some independent authority was constituted which would have both the will and the power to deal with these matters in a comprehensive fashion, no improvement could be looked for.

Mr. R. B. GRANTHAM (Associate of Council) said that the proposal to make the watershed the limit of jurisdiction

had received great attention at the hands of the Royal Sanitary Commission. It was suggested that every part of the watershed area should contribute so much per acre to the improvement of the main outfalls. He believed, however, that the proposition of taxing the whole of a watershed had not received much support, and it was certainly very contrary to the usual practice in taxing areas for the improvement of rivers. Under the Land Drainage Act only that portion of the district immediately affected by the drainage was subjected to taxation in support of it. In the instances (about thirty in number) where he had been called upon to inspect districts for drainage purposes, he had suggested that the limit for taxation purposes should be a contour line, 5 feet above flood water.

It might not be out of place to mention that the Duke of RICHMOND AND GORDON's Committee on Rivers Conservancy, &c., was now conducting an inquiry, which would probably elicit much useful information with respect to the condition of rivers; and it was to be hoped that some of the members of the Institution would give evidence before that Committee.

For some time past he had been endeavouring to classify the rivers according to their water-sheds, commencing with the largest and carrying the tabulation down to streams whose water-shed did not exceed ten square miles. When completed it would present what he believed would be a very useful analysis for purposes of river improvement.

Mr. J. CLUTTON (Past President) had always felt that the great difficulty in dealing with rivers in this country arose from the division of responsibility as described by Mr. MICHAEL. Nor was this division of responsibility the only evil of the existing system; for, as at present constituted, local authorities could not be induced to do anything.

They were far too much afraid of their neighbours and for their own pockets.

What seemed to him to be wanted was a prominent and comprehensive authority for each water-shed. Take, for example, the valley of the Thames, the whole of which should, he thought, be under the jurisdiction of one body of Commissioners, who should appoint sub-Commissioners to look after the tributary streams. As matters now stood, it was impossible to get the streams cleared, either because there was no authority, or because it was so constituted as to be practically inefficient. Matters appeared to be getting worse, and the streams were far more choked up now than in the days before the water-closet system was introduced.

Mr. C. HIGGINS (Visitor) said that he had carefully watched the course of criticism upon the Act of Parliament under discussion, not only in that room but elsewhere, for some time past, and the result of his observations was that the view taken of the Act depended entirely on the position of the criticizer. Those who had large landed and riparian interests thought the provisions of the Act too mild, whereas those who had, or represented, manufacturing interests, thought them too severe. In criticizing this Act of Parliament, it was desirable, therefore, to place oneself as far as possible, in the position of the Legislature. The principle from the legislative point of view was this—to get if possible pure rivers, to preserve them pure, to bring back those that were polluted to their original state of purity; but to do this only as far as was consistent with the manufacturing interests of the community on which our national prosperity rested. That this was the principle of the Act was evident on reading its provisions. It was observable that vested interests were touched with a delicate hand, and rightly so; but the Act made stringent provisions against the creation of *new*

interests incompatible with the purity of the rivers. The provision relating to sewage matter was simply that no sewage should pass into the rivers through any channels, save those constructed before the passing of the Act, and then only after the best practicable and available means had been used to purify it. So also with manufacturing pollutions. It should be borne in mind that enormous sums of money were invested in the construction of works, and on the systems employed to carry away the refuse, which was allowed to pass into the rivers, and such works should not be interfered with when the best available means had been used to purify such refuse.

With regard to mining pollutions, he considered there was a defect, and it was this, that any water, no matter how impure, was allowed to pass into the river, provided it had not been treated from the time of leaving the mine to the time of its reaching the river. In some cases—in the case of copper mines, for instance—this would work as a great hardship. It was not often that copper found its way into rivers, on account of the value of the metal, but it occasionally did so, and was then always accompanied by arsenic, notwithstanding which it was no offence, under the Act, to allow it to pass into the river. If, however, after being treated with scrap iron, which was the usual process employed for separating the copper, it was allowed to flow into the river, it became an offence against the Act.

Thus the Act allowed a liquid containing two poisonous substances, copper and arsenic, to be turned into the rivers, but prohibited the same liquid, after one of those poisonous substances had been replaced by a comparatively harmless one, to be got rid of in a similar manner.

The great weakness of the Act was the machinery for putting it into operation, and he could not agree with Mr. MICHAEL's view that a right on the part of individuals

to proceed under the Act, would be a misfortune, for all the interests—manufacturing and otherwise—seemed to him to be sufficiently protected. The jurisdiction of the county court judge seemed to him to be a vanishing quantity. If the certificate of the inspector was produced that was *conclusive* evidence, and in the absence of that an array of scientific evidence would be produced, of equal authority on either side, and the county court judge would be left to decide between the professors who disagreed, and that without the assistance of the standards of purity which had been framed by the River Pollution Commissioners. Under these circumstances the judge was almost certain to “remit” the question to “skilled parties.” The standards of purity would produce no hardship for they were so framed that, if the processes *known at the present time* for the purification of polluting liquids were employed, no manufacturer or sanitary authority would infringe these provisions. Such processes were fully described in the various reports of the Commission.

The Act, so far as it went, was good; but, as he had said, the machinery for putting it in operation was defective. If it were allowed to come into operation next August, in its present form, and without the amendments which had already been asked for, its defects would very soon appear, and the information acquired would enable the Legislature to determine what amendments were needed either in the machinery or in the principle of the Act.

Mr. E. RYDE (Vice-President) said that, as it appeared to be the general wish of the Meeting, he begged to move the adjournment of the discussion. Pollution on a large scale, caused by manufacturing processes in populous districts, had received a good deal of attention in the course of the discussion; but there was another and a humbler class of cases, to which he hoped that some of the members would

address their remarks at the next meeting. There were many districts, the rivers in which had been perfectly pure and well stocked with fish within the memory of living persons, and these rivers were formerly enjoyable features of the country; but many of the old-fashioned country corn-mills had, in modern times, been converted into paper-mills, which brought their population with them. The scientific processes for making paper caused pollutions in the streams, which destroyed the fish and constituted a serious nuisance for the people living on their banks.

These were comparatively trifling grievances, but surely something should be done to prevent pollutions of the kind, even though it should interfere, to some extent, with the industry itself. He could not help thinking that, as a matter of equity, there should be a remedy against those who interfered with the pre-existing and natural state of things. Paper must be made, and, if it were not made in one place, it would be in another. In a district with which he was acquainted, there was a tan-yard adjoining what was formerly a very enjoyable residential property. The tanner's business had largely increased, and the quantity of noxious refuse thrown into the river was consequently now so great that the cows could not drink the water. He feared that cases of this kind could not be very readily dealt with under the Act, for both the paper-maker and the tanner would probably be able to show that they had taken all available means to avoid creating the nuisance.

The PRESIDENT said, before adjourning, there was one point in the discussion on which he wished to make an observation. The proposal that the country be divided into districts corresponding with the different water-sheds appeared to him to be expedient; but not without limitation. The river Nene water-shed was formed into a single district,

under an Act of Parliament, some time ago. Towards the outfall there was a town which was also a port; higher up there was an ancient city; higher up there was an extensive agricultural district—each of these three interests having under them other interests of infinitely various kinds. The three chief interests fought each other on every conceivable point, because, in fact, the interests of the upper part of the district were opposed to the interests of the other end, and the city on the river had its own peculiar interests. On almost every stream in England precisely the same circumstances would be found; the owners on the upper part not caring at all about the lower part. It had been proposed that all the area within each water-shed should pay a tax; but the owners on the hill-sides could never be shown the advantage of their paying a tax for the water running off their hills. If water-sheds were constituted into districts, they should, instead of being governed by an interested person chosen out of the district itself, be governed by persons not connected with it. The difficulty of guarding against the representatives taking care of the interests of the particular part in which their own interests were, constituted, and always would constitute, the difficulty of taking the area of each particular water-shed as a district. The addition of members appointed by the Board of Health, or other central Board, and not connected with any particular portion of the river, might overcome the working difficulty; but it would require to be met in some manner.

The discussion was then adjourned to the next meeting.

AT
THE ORDINARY GENERAL MEETING

Held on Monday, May 14th, 1877.

THE PRESIDENT IN THE CHAIR.

The discussion on the Paper read by Mr. J. SHAW, at the Meeting on the 16th April, on "The Rivers Pollution Prevention Act, 1876," was resumed.

Mr. E. RYDE (Vice President), said that he moved the adjournment at the last Meeting, because he was given to understand that it was the wish of several gentlemen then present to take part in discussion. So far as he was personally concerned he had nothing to add to what he had already said. What was needed, in country places especially, was an authority which would take the initiative and relieve individuals from the invidious task of proceeding against their neighbours. Assuming a local authority with powers of this nature, there could be no doubt that it would find abundant scope for their exercise.

He was not insensible to the objection urged by the President against legislation of such a kind as would tend to interfere with useful industries and throw large classes of men out of employment; but he could not help thinking that there were many wanton nuisances which called loudly for suppression by the strong arm of the law.

Mr. F. JACKSON (Member) observed that the Rivers Pollution Prevention Act dealt with most diverse and most

extensive interests, not only in the great manufacturing towns of the north, but in every part of the country where manufacturing industries were carried on, and it was very desirable to exercise great caution in coming to a decision with reference to this measure until it was seen how it would operate. It would, no doubt, be very difficult to embody in any Act anything like a permanent remedy for the evils complained of, for they were changing in character every year. Take the operation of bleaching, for instance. This process was carried on extensively in the valley of the Leen, near Nottingham, and disputes had arisen with regard to the discharge of refuse from these works. In former times, the process of bleaching was carried on by very simple means, but at the present time the chemical agencies employed in this department of trade had become and were becoming daily, much more extended, thereby increasing the difficulty of dealing legislatively with them.

Bleach-works required the purest of water, and a ready means for the carrying away of waste highly charged with chemical ingredients, as well as with more or less solid substances; and any Act which compelled an entire change, thus seriously affecting and crippling this practice of science and art, must of necessity, for a time at least, be inoperative.

It was all very well for the Legislature to say that the rivers must be purified, (as, indeed, they ought to be,) but tacit permission having been given by the Legislature to foul the rivers in pursuing the industrial arts, provision must be made by the same authority for compensation, or for a mode of keeping rivers and streams pure, without injuriously affecting vested interests. If neither of these things were done, the Act must continue a dead letter. Such being the position of matters, he certainly thought, with Mr. MICHAEL and Mr. HARRISON, that this Act was only meant as a

tentative one, and was, practically, inoperative—a sort of warning bell to prepare for future more extended and more stringent legislation. He would, therefore, venture to suggest that the members of this Institution should act very cautiously in the advice they gave their clients. Let them exercise their judicial authority, and, in their laudable desire to assist towards the consummation of so desirable an object as the purification of the streams, have regard to the many and complicated vested interests which have been permitted by the Legislature to grow and establish themselves, studying how to effect the ends sought for with advantage to commerce as well as to the community at large.

Mr. J. C. MELLISS (Visitor) said that he had given great attention, during the last four or five years, to the question under discussion, and had watched with interest the endeavours of the Government to deal with it by means of legislation. He rejoiced to think that a Rivers Pollution Prevention Act had been passed at all, for it was a step, at any rate, in the right direction, whatever its faults and shortcomings might prove to be. It must be remembered that the Government had a most difficult task to accomplish, seeing the number of conflicting interests to be considered.

The Act appeared to him to be likely to lead to very much better things if an effort were made to assist future legislation by carefully observing the working of the Act in its present form.

There was one point in the Act which had been apparently lost sight of in the discussion—the formation of Conservancy Boards; and he doubted very much whether much could be done, practically, without the formation of such Boards.

There was no doubt whatever that the Act was creating

a stir in the country, and he had himself been called on to advise Towns with reference to their drainage and the disposal of their sewage, in anticipation of its coming into force.

Mr. D. WATNEY (Member) considered that any Act passed to improve the state of the rivers should be hailed with satisfaction, for they had become so polluted as to threaten a serious interference with the health of the kingdom. It was a great point to have succeeded, in face of the opposition of interested parties, in passing an Act to prevent future pollution. The Legislature, he thought, had exercised a wise discretion in not making its provisions of too sweeping a character. The uncertainty, and the heavy expenses attending proceedings under the old Acts of Parliament, had deterred many people from attempting to enforce their rights. As a case in point, he would refer to the *Times* of that day, in which would be found the report of a decision with reference to the pollution of a stream at Isleworth. The plaintiff had brought the matter to judgment, but had obtained no redress at all, the case being simply allowed to stand over for nine months, in the hope that something would be done in the meantime to abolish or mitigate the nuisance. This was tantamount to saying that the plaintiff was right, but could get no redress. In view of this and similar decisions, it seemed to him that any legislation which protected individuals from the acts of the millowner and the manufacturer ought to be welcomed.

Mr. R. W. PEREGRINE BIRCH (Associate) could not quite agree with Mr. RYDE in wishing to take away from the evil doers their only excuse, which was that they were doing their best to amend their ways; nor did he agree with Mr. HARRISON in his proposal to take away from Sanitary Authorities the option of enforcing

the Act. He was of opinion that the various rivers throughout the country must be treated with reference to special local circumstances. So far as the rivers in the manufacturing districts were concerned, it was, no doubt, a commercial necessity that they should be purified at once. The case, however, was different with regard to rivers passing through residential property, as the attempt to enforce their purification would result in stopping the outfall, and driving the sewage back into people's wells and houses. By striking too hard at one evil, it was possible, therefore, that another might be created.

If the Act, even though in itself valueless, served to indicate that the Government was turning its attention to the subject, it was as much as could be expected at present; and he hoped much more from the spread of education among the people, than from any legislative steps.

Mr. T. STATTER (Member) said that he held a strong opinion that many of the rivers of England need not be polluted as they now were, seeing that science had furnished methods by means of which waste products could be utilized, and actual profit secured from what was formally thrown away. He happened, for instance, to know one firm connected with the copper-smelting trade which was now making a large profit from the precipitation of the arsenious acid which was formerly wasted, polluting the atmosphere, and destroying the vegetation of the surrounding districts. If this could be done in one case it could be done in others. He believed that a great saving might be effected by retaining and utilizing the residuums which now passed into the rivers from many manufactories. Little regard, he was sorry to say, was had to existing legislation with reference to the deposit of ashes, foundation materials, cinders, and all kinds of heavy residuum in the rivers, each man feeling

that compliance with the Act on his part only, would place him in a position of disadvantage with his neighbours, who availed themselves of the rivers for getting rid of their refuse. Judicious legislation might possibly do much to remove this feeling; and if manufacturers could be shown that their waste could be profitably dealt with—or, at all events, at a reasonable cost—much of the existing pollution might be avoided. The great objection was the permissive character of the Act. To be useful at all, it should be compulsory, and people should be appointed to see that its provisions were carried out, and to impose penalties on those who disregarded them. He believed that if some measure of the kind were passed there would be no difficulty in cleansing the rivers, and by proper filtration and subsidence of manufacturing residuum, and by excluding solid matters, they might be kept reasonably pure; if not so pure that fish would live in them—although, for that matter, he had known instances where filtration had been so effectively carried out that the fish had returned to the streams—at all events, in sufficiently good condition to pump on to filter-beds as was done in various parts of Lancashire. The absence of so much solid matter would prevent the clogging of the filters which now took place, and consequently about double the quantity of water would pass through them fit for manufacturing purposes though not for domestic consumption. At the present time the Irwell bubbled with gases in the neighbourhood of Manchester, and in those parts of the river where weirs existed the sluggish currents gave off most noxious and objectionable emanations.

The Roch, the Irk, the Madlock, the Mersey, and many other rivers in Lancashire were in the same condition. In Yorkshire, there was the Calder and its tributaries running for 60 or 70 miles through a manufacturing district, which contributed its filth throughout the entire length of the stream,

principally from the scouring of wool and flannels. There was no doubt that in most of these cases extraction ought to take place before the waste water was turned into the stream. As had been pointed out at a previous meeting, the people of Wakefield, until lately, were supplied with water pumped from the Calder, with all the excreta and all the filth and washings of the entire valley. Science had found a way of purifying that water by means of the hematite filter, which rendered it bright and inoffensive to the smell; but it was none the less objectionable that the population of Wakefield should be subject to the risk of using water from a source so polluted. By a system of precipitation and filtration combined, he felt satisfied that the purification of the rivers might be satisfactorily effected.

Mr. SHAW after acknowledging the vote of thanks, said that he was gratified to find that the views which he had ventured to propound had met with such general acceptance.

Before he proceeded to allude to the discussion, he wished to observe that he had been struck with a misapprehension which appeared to exist in the minds of a great number of people, that since the Act had been passed the hitherto existing powers at common law and under the Court of Chancery, were now extinct. He wished particularly to call attention to the Report of a deputation which waited on the Local Government Board, a week or two ago, from the Fisheries' Association. One gentlemen said that he had twice prosecuted polluters, and had succeeded, but that if the new Act remained in force, as it stood, he could not hope to do so again. This however seemed to him (Mr. SHAW), to be a complete fallacy. On referring to the 16th Section of the Act, it would be found that "The powers given by this Act shall not be deemed to prejudice or affect any other rights or

powers now existing or vested in any person or persons by Act of Parliament, law, or custom, and such other rights or powers may be exercised in the same manner as if this Act had not passed." It was quite clear to him, that the same powers now existed as before the passing of the Act. The only effect which it had upon powers previously existing was this:—"Provided nevertheless that in any proceedings for enforcing against any person such rights or powers the Court before which such proceedings are pending shall take into consideration any certificate granted to such person under this Act." Thus, there was a provision that any certificate granted under Section 12 by a Local Inspector should be taken as evidence, but nothing more than evidence; therefore, he thought it clear that whatever powers existed before, existed also at the present time.

One speaker had observed, in discussing the Act, that a good deal depended on the position of the criticizer—whether his interests were large landed interests or manufacturing interests. He ventured to think that both sides had received fair consideration in the course of the discussion. As he had said, the Act practically resolved itself into what were the best means of treating the sewage and refuse of Towns? All were generally agreed that the test applied in the Act was the true one, and the only question was how it should be carried out? It was, he thought, manifest that no one system could be applied to every case. The best means must be adopted according to the particular circumstances of the case. Mr. COLLINS, who spoke on the first night of the discussion, had had great experience in the district to which Mr. STATTER had referred, and these gentlemen with Mr. GREY and others appeared to think there was less practical difficulty than he (Mr. SHAW) apprehended, in dealing with manufacturing refuse independently on the premises, as he had proposed. He

thought the President had put the matter very clearly when he said, "It is an accepted fact that all sewage should be diverted from the rivers, the only question being the best mode; so that the cessation of the industrial impurities is really the chief object now to be secured. The Act under discussion enables this object to be attained so far as is consistent with the continuance of the industry."

As he had said in his Paper, he considered the absence of any power to deal with the alteration of weirs and the removal of mills or other artificial or natural obstructions,—the cause of much pollution—a serious defect in the Act, and one which should be removed by future legislation.

It was a great satisfaction to him to find that the view which he had submitted with reference to the union or combination of districts, or the formation of new districts, for which there was no provision in the Act, had been generally received in the discussion, and that the appointment of Conservancy Boards had been supported by the President, Mr. MICHAEL, Mr. CLUTTON, and other gentlemen. As the President, however, had observed, great care was necessary in the formation of such districts and the composition of the Boards—a point of great importance, since upon this would depend the successful operation of the Act.

It was said by Mr. MICHAEL that he regarded the Act as a tentative one, passed for the express purpose of being amended. Although he agreed with Mr. MICHAEL that considerable amendment was necessary, he could not go to the full length with him, for he believed that there was a great deal of real good in the Act. Mr. MICHAEL also observed that, "There was one great difficulty in the administrative portion of the Act. By Section 6, the Local Authority was to carry into effect its provisions." This was evidently a misapprehension, for the operation of Section 6 was confined to Part 3 of the Act, and had no reference whatever to any other part of it.

The words of the Section were, "Proceedings shall not be taken against any person *under this part of the Act*," viz., that referring to manufacturing and mining pollutions. Therefore, Part 2 of the Act dealt with sewage pollution generally, and Section 8 gave power to the Sanitary Authority or other persons to take proceedings. As he pointed out in his analysis of the Act, there was no power to compel a Sanitary Authority. This was an omission, and one which ought, in his judgment, to have been provided for.

The 8th section—he would read his own analysis of it—was important: "It not only gives full powers to any Sanitary Authority to enforce the provisions of the Act against the interference with the due flow or the pollution of any stream within, through, or by any part of their district, and provides for the expenses of such proceedings; but it also enables any proceedings to be instituted by any person aggrieved, subject in either case to the restrictions in the Act, in Sections 6 and 13. At the same time, there is no provision for putting the authority into motion." That, as he had said, was an omission which ought to be remedied.

One remark made by a learned counsel (Mr. HARRISON) at the last meeting did not quite clearly describe the practical operations of the Act. He said: "What was likely to be the effect of Sections 2 and 3? Absolutely nothing, he believed. The Act, it seemed to him, might even have a bad effect; because, whereas before it was passed the owners of property felt themselves under some sort of obligation to clear out the streams and keep them pure and fresh for the advantage of themselves and their tenants, he was inclined to believe that this would no longer be the case; for they would say, 'There is the Sanitary Authority; let them do it.'" Speaking from considerable experience in rural sanitary districts, he (Mr. SHAW) did not agree with Mr. HARRISON; for he had found, on the contrary,

since the Act was passed, that the owners of streams, however small the streams might be, and the inhabitants of the districts, however small the districts might be, had become very much more alive to these pollutions than they were before.

Part 2 of the Act commenced by saying, "Every person who causes to fall or flow, or knowingly permits to fall or flow, or to be carried into any stream, any solid or liquid sewage matter, shall (subject as in this Act mentioned) be deemed to have committed an offence against this Act." Then followed an exception, with reference to existing works, which seemed to him to be a very proper one. In the case of existing works, all that had to be done was to show "to the satisfaction of the Court having cognizance of the case, that the person (proceeded against) was using the best practicable and available means to render harmless the sewage matter so falling or flowing or carried into the stream."

He was not a lawyer, and was not competent to give, in all cases, the strict interpretation of an Act of Parliament, but the clause seemed to mean that, in the case of all existing sewers, all that was necessary was to show that the best available means had been adopted; but, that in the case of new sewers and pollutions, an absolute prohibition was imposed.

Part 2 of the Act must be read in connection with Clause 10, which gave power to the County Court not only to make a summary order, but also to remit the question of the best practicable and available means to skilled parties; and, that being so, it appeared to him that, practically, very little sewage or polluting matter—or at any rate new pollutions—would, in future, be allowed to pass into the streams.

On the whole, the Act was a good Act, but needed

further administrative powers. It was desirable also that future legislation should provide for the appointment of Conservancy Boards, the members of which should be so selected as to act independently of local influences, and take all necessary proceedings on their own initiative. An authority so constituted would command public respect, and would be competent to give advice in difficult cases, and thus prevent a great deal of litigation. He trusted that the discussion had been the means of eliciting useful information on this important subject.

The Meeting then adjourned.

THE ANNUAL GENERAL MEETING,

Monday, May 28th, 1877.

EDMUND JAMES SMITH (PRESIDENT) IN THE CHAIR.

Messrs. R. F. GRANTHAM and F. W. CARDALL, having been requested to act as Scrutineers of the ballot for the Election of Council, the balloting list submitted by the Council in accordance with the bye-laws, and the record of attendance of the Members of Council, were read, and the ballot declared open.

The Report of the Council on the state of the Institution, and the Statement of Receipts and Expenditure for the year 1876 were read.

RESOLVED—"That the Report of the Council and the Balance Sheet be received and approved, and be printed and circulated with the 'Transactions.'"

RESOLVED—"That the thanks of the Institution be given to Messrs. A. GARRARD and R. VIGERS for the efficient performance of their duties as Auditors, and that they be requested to continue their services for the ensuing year."

RESOLVED—"That the thanks of the Institution are due and be given to the President, the Vice-Presidents, and the other Members and Associates of Council, for the able manner in which they have administered the affairs of the Institution."

RESOLVED—"That the thanks of the Institution be given to Mr. JOHN WORNHAM PENFOLD (the Honorary Secretary), to Mr. JULIAN C. ROGERS, to the Treasurer, and other Officers of the Institution, for the able manner in which they have executed their several duties."

The ballot having been closed, the Scrutineers reported that the following gentlemen had been elected as Council for the ensuing year:—

President.

EDMUND JAMES SMITH.

Vice-Presidents.

JOHN OAKLEY	EDWARD RYDE
WILLIAM STURGE	THOMAS SMITH WOOLLEY

Members of Council.

WILLIAM JAMES BEADEL	ELIAS PITTS SQUAREY
ROBERT COLLIER DRIVER	CHARLES STEPHENSON
FRANCIS VIGERS	DANIEL WATNEY
VIRGOE BUCKLAND	WILLIAM SCARTH
CHARLES JOHN SHOPPEE	EDWARD I'ANSON
THOMAS CHATFEILD CLARKE	JAMES MARTIN

Associates of Council.

ROBERT BOXALL GRANTHAM	FDK. ADOLPHUS PHILBRICK
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RESOLVED—"That the thanks of the Meeting be given to Messrs. R. F. GRANTHAM and F. W. CARDALL, for their services as Scrutineers."

A vote of thanks to the President for his conduct in the Chair having been passed unanimously, the Meeting separated.

THE NINTH
ANNUAL REPORT OF THE COUNCIL.

ANNUAL GENERAL MEETING, MAY 28TH, 1877.

THE Council have again the pleasure of reporting that the affairs of the Institution continue to prosper, and to justify their confidence that it will pursue a long career of usefulness.

The incidents of the past year call for little special comment. The usual statistical summary, and a few observations with reference to the management and disposition of the funds of the Institution will therefore constitute this Report.

During the year 2 Honorary Members, 14 Members, 19 Associates, and 5 Students, have been admitted into the Institution. Three Associates, having become eligible, have been transferred to the class of Members. The Institution now numbers 8 Honorary Members, 302 Members, 133 Associates, and 11 Students, making a total of 454 persons enjoying its advantages.

It is with the greatest regret that the Council record

the death of Mr. ROBERT CLUTTON, of Hartswood, and Whitehall Place. His name is closely associated with the foundation of this Institution, but he was long previously one of the founders of the Land Surveyors' Club of 1834. That and other similar Institutions, both in London and in the country, being necessarily limited as to numbers, failed to meet the requirements of the profession, but tended to justify the establishment of this Institution. In the death of Mr. JAMES INNES, of Wroxton, the Institution loses another highly esteemed Member. Obituary notices of some of these Members, as well as of Mr. G. A. CHANDLER, Mr. T. J. R. DAVISON, and Mr. G. H. ELWIN, Associates of the Institution (whose deaths the Council have heard of with regret), will be found in the Appendix to this Report.

As compared with the previous year, the revenue derived from subscriptions (which is regarded as the income proper) shows a satisfactory increase. The total revenue is somewhat less than last year, because the possession of the first-floor rooms, which had hitherto been let at a considerable rental, was resumed by the Institution from November, 1875. The immediate result was, necessarily, a decrease of income, but the Council are satisfied that an increase of revenue will accrue from the enlargement of the accommodation for arbitration purposes. The Council have now determined to take into possession the upper floors of the house, which alone remain in the occupation of other persons, being of opinion that the permanent interests of the

Institution will be best consulted by retaining the whole of the property in its own occupation.

The Council have the gratification of stating that a further sum of £500 within the year has been applied toward the extinction of the building debt, so that there has been a total reduction of £1,175 out of less than £3,000 in the course of $3\frac{1}{2}$ years. It is proposed to apply, during the present year, any available balance towards the same object, and the Council expect to be able to clear off the whole debt within a very moderate period.

The Balance Sheet for the year ending December 31st, 1876, shows the following results :—

RECEIPTS.			EXPENDITURE.—		
	£	s. d.		£	s. d.
Total Revenue . . .	1,726	12 9	Total payments out of		
Revenue Balance in			Revenue—Current		
hand, January 1st,			Expenses	1,354	15 11
1876	63	11 4	Transferred to Capital	350	0 0
Entrance Fees carried			Revenue Balance in		
to Capital Account	289	16 0	hand, December		
Transferred from Re-			31st, 1876	85	8 2
venue	350	0 0	Total payments out of		
Sale of Investment . .	250	0 0	Capital—Buildings		
Capital Balance in			and Furniture . .	446	0 0
hand, January 1st,			Debentures paid off .	500	0 0
1876	79	7 5	Interest on same . .	22	0 10
			Capital Balance in		
			hand, December		
			31st, 1876	1	2 7
	<u>£2,759</u>	<u>7 6</u>		<u>£2,759</u>	<u>7 6</u>

In addition to the above cash balances, stock to the amount of £347 3s. Consols, and £141 16s. 9d. New Three per Cents. (of which £100 is invested in the Library account),

stood to the credit of the Trustees of the Institution of Surveyors on the 31st of December, 1876.

A summary of the receipts and expenditure for the present year, up to this date, is as follows:—

RECEIPTS.			EXPENDITURE.		
	£	s. d.		£	s. d.
Total Revenue . . .	1,284	12 7	Total payments out of		
Revenue Balance in			Revenue—Current		
hand, January 1st,			Expenses	428	5 0
1877	85	8 2	Interest on Mortgage		
Entrance Fees and			Debenturés	69	3 2
Life Compositions			Revenue Balance in		
carried to Capital			hand, May 22nd,		
Account	150	3 0	1877	872	12 6
Capital Balance in			Payments out of Capital—Furniture, &c.	49	10 0
hand, January 1st,			Capital Balance in		
1877	1	2 7	hand, May 22nd,		
			1877	101	15 7
	<u>£1,521</u>	<u>6 4</u>		<u>£1,521</u>	<u>6 4</u>

In addition to the above cash balances, the amount of stock now invested in Consols is £347 3s., and in New Three per Cents, £141 16s. 9d.

The Library balance in hand is £164 19s. 10d., in addition to the £100 invested in New Three per Cents.

The total liabilities for rent, rates, printing, and current expenses amount to about £300.

The papers and discussions during the past Session have dealt principally with the various phases of water supply, and the rights and obligations of those who use or abuse the sources from which water supply may be derived. The question involved being, at the present time, the subject

of special legislative attention, the Council considered it desirable that the various branches of the subject should be thoroughly examined, so as to present, as much as possible, a general view of the whole question. These papers are all of great interest, and for one of them (that on rainfall), the Council are indebted to Mr. G. J. SYMONS, a gentleman unconnected with the Institution.

The objections urged by many of our members against various points of principle in the Valuation Bill introduced in the last Session, have evidently been recognised in the preparation of the Bill now under the consideration of Parliament. In view of this fact the Council have not considered it necessary that the details of the new Bill should be discussed by the Institution.

The Council desire to point out that some of the Members and Associates have omitted to notice the obligation into which all enter at the time of election, to either deliver an original paper, or to make a donation to the Library. The observance of this rule materially affects the future growth and consequent usefulness of the Library.

The Council take this opportunity of specially acknowledging the liberality of Mr. G. WEBB, of Tunstall, in presenting to the Library a valuable copy of the folio edition of Hasted's "History of Kent."

In conclusion, the Council beg to thank the Members for the support which they have received from them in the discharge of their duties during the past year.

STATEMENT OF RECEIPTS AND EXPENDITURE

RECEIPTS.			REVENUE	
	£	s. d.	£	s. d.
1876.				
267 Members' Subscriptions for 1876, £3 3s.	841	1 0		
1 " " in advance for 1877	3	3 0		
9 " Arrears at £3 3s.	28	7 0	872	11 0
92 Associates' Subscriptions for 1876, at £2 2s.	193	4 0		
1 " " in advance for 1877.	2	2 0		
2 " Arrears at £2 2s.	4	4 0	199	10 0
9 Students' Subscriptions for 1876, at £1 1s.			9	9 0
Rent of Offices and Hire of Arbitration Rooms				1,081 10
Dividends				625 15
Cash in hands of Treasurer and Secretary, January 1st, 1876				19 7
				63 11

£1,790 4

CAPITAL			CAPITAL	
	£	s. d.	£	s. d.
28 New Members' Entrance Fees for 1876, at £5 5s.	147	0 0		
5 Members' Entrance Fees, Balance on Transfer, at £2 2s.	10	10 0	157	10 0
22 New Associates' Entrance Fees for 1876, at £3 3s.			69	6 0
1 Member's Life Composition	31	10 0		
1 " " Balance on Transfer	10	10 0		
1 Associate's Life Composition	21	0 0	63	0 0
Cash transferred from Revenue.				289 16
Sale of Stock				350 0
Balance in hands of Treasurer, December 31, 1875				250 0
				79 7
				£969 8

LIBRARY			LIBRARY	
	£	s. d.	£	s. d.
Donations, 1876				
Dividends				67 17
Balance in hands of Treasurer, December 31, 1875.				3 0
				206 7
				£277 5

SUM			SUM	
	£	s. d.	£	s. d.
Revenue Account				
Capital				1,790 4
Library				969 8
				277 5
				£3,036 12 1

ASSETS AND			ASSETS AND	
	£	s. d.	£	s. d.
Cash in hands of Treasurer and Secretary				
Value of Furniture and Books				257 16
Invested in New Three per Cents. and Consols				1,705 9
" " " Library				375 10
Subscriptions and Entrance Fees due, but unpaid at date				100 0
Value of Premises, No. 12, Great George Street				120 15
Fees for Use of Rooms due, but unpaid at date				5,000 0
				62 9
				£7,622 0

THE YEAR ENDING DECEMBER 31ST, 1876.

(C O U N T.		£	s.	d.
ure and Fittings	.	149	1	6
ption of Bonds and Interest	.	522	0	10
ng and Decorating	.	296	18	6
ee in hands of Treasurer	.	1	2	7

R Y.										£	s.	d.
Age	.	.	.	.	.	.	.	.	.	1,704	15	11
1.	.	.	.	.	.	.	.	.	.	968	0	10
2.	.	.	.	.	.	.	.	.	.	105	19	10
Age in hands of Treasurer and Secretary	.	.	.	.	.	.	.	.	.	257	16	8
										£3,036	12	10

Examined with the Books and Vouchers, and found correct,
May 16th, 1877.

ARTHUR GARRARD, } *Auditors.*
ROBERT VIGERS, }

APPENDIX TO VOL. IX.

Obituary.

GEORGE ALFRED CHANDLER (Associate) was the son of Mr. GEORGE CHANDLER, who practised as a Surgeon at Godalming, Surrey. Mr. CHANDLER served his articles with Mr. J. W. PENFOLD, and commenced practice on his own account at Godalming, but shortly after was seized with an attack of typhoid fever, which terminated fatally. His death took place at Godalming, on the 5th of January, 1877, in the 28th year of his age.

ROBERT CLUTTON (Member) was born on the 8th October, 1801, and died on the 1st February, 1877, at Hartswood, near Reigate, where his father farmed and practised as a land agent and surveyor.

For two years, from 1817, he was in the office of Mr. HENRY WALTER, of Holyport, near Windsor. From the close of that period he assisted at Hartswood, both in the agencies and in the farming, until his father's death in 1839.

Hartswood was bequeathed to him by his father, and he continued to reside there, and was also the senior member of the firm of Messrs. CLUTTON, with offices in Whitehall Place, until his death. His business transactions ranged, therefore, over a period of 60 years.

The Hartswood business consisted chiefly of private agencies in Sussex, Surrey, and the southern counties, and the London business extended into most of the counties, and included several public appointments

He was largely engaged in timber valuing, in the

enclosure of commons, and in commutations of tithes (the first of the latter having been effected by him at West Grinstead, the late Mr. SMITH WOOLLEY being the Assistant Tithe Commissioner), and in exchanges, and in the valuation, sale, and purchase of estates by private contract.

From 1852 his professional engagements were made subordinate to his farming predilections, and to the improvement of the Hartwood property; and his genial and kindly disposition devoted itself very much to the promotion of the welfare of the district, and especially of his poorer neighbours.

As Chairman of the Board of Guardians and of the Highway Board, and as a county magistrate, he embraced every opportunity of sympathizing with local objects, and bringing his influence to bear upon the support of well-considered improvements.

A few days' illness, occasioned by exposure when shooting with friends upon his property, closed somewhat suddenly a life which had throughout been characterized by unswerving integrity, high-minded judgment, unvarying urbanity, and consideration for others, as well as the practice of the particular duties which constitute the best work of our profession.

Few men live so long; still fewer live so well; and no one of our founders recognised more entirely the advantages to be derived from the establishment of this Institution; of which his brothers and nephews are prominent Members.

THOMAS JOHN ROBERT DAVISON (Associate) was the third son of the late Rev. JOHN DAVISON, Canon of Worcester Cathedral, Rector of Upton-upon-Severn, Worcestershire, and well known as the author of "The Discourses on Prophecy." Mr. DAVISON was born at

Upton-upon-Severn, on 26th September, 1832, and was educated at the Cathedral School at Worcester and at Repton School, Derbyshire. After leaving school he was articled to Messrs. HYDE & TYMBS, solicitors, of Worcester, and subsequently studied in the chambers of Mr. MILES FRANCE, the conveyancer. After being some years in the Bedford Office, Bloomsbury, Mr. DAVISON was appointed steward of the Duke of BEDFORD'S London estate, which office he held at the time of his death, which took place in London on the 13th April last, after less than four days' illness.

He combined natural talent with great industry and perseverance, sparing neither time nor trouble in carrying out his responsible duties, which he discharged to the complete satisfaction of all with whom he was connected.

JOHN ELLIS (Member) was a son of Mr. ISAAC ELLIS, of Artington Manor, Guildford.

Mr. ELLIS practised for many years as a Surveyor and Valuer at Guildford, and the surrounding neighbourhood, and enjoyed a wide reputation as an able agriculturalist and for practical knowledge of matters connected with the tenure and cultivation of land.

For many years previous to his death Mr. ELLIS filled several important local offices, with which his memory will long be identified.

On the formation of the Institution in 1868, Mr. ELLIS at once associated himself with his brother Surveyors in this effort to promote the welfare of the profession and never ceased to take an interest in its progress until declining health compelled him to retire from business.

Mr. ELLIS died at his residence, at Weybourne, near Guildford, after a long illness, on June 5th, 1877, aged 56 years.

GEORGE HARVEY ELWIN (Associate) was a son of the late Rev. T. H. ELWIN, Vicar of East Barnet, Herts.

Thirty years of Mr. ELWIN's life were spent in the offices of the London & South-Western Railway Company, where, after filling a number of minor appointments, he succeeded the late Mr. HORNE as head of the Rates and Taxes Department, which was subsequently amalgamated with the Estate Office, of which for many years he remained the head. Mr. ELWIN died on the 16th of October, 1876, aged 54 years.

CONTRIBUTIONS IN MONEY TO LIBRARY FUND.

From June 1st., 1876, to June 1st., 1877.

	£	s.	d.
Bidwell, S.	3	3	0
Bingham, R.	2	2	0
Bolam, H. G.	5	0	0
Cassell, J. R.	3	3	0
Clayden, W.	1	1	0
Cross, J.	3	3	0
Cruse, E.	2	2	0
Gairdner, E. J.	5	5	0
Gwyther, W. W.	2	2	0
Harding, W. D.	3	3	0
Kaye, J. E.	2	2	0
Ledgard, F. T. D.	3	3	0
Lee, G. C.	1	1	0
Martin, G.	5	5	0
Nevile, H. W.	2	2	0
Oakley, W.	5	5	0
Parker, F. S.	5	5	0
Rich, R.	3	3	0
Sadler, G. W.	2	2	0
Shackel, G.	2	2	0
Smith, H.	2	2	0
Stephenson, Christopher	3	0	0
Strutt, E. G., The Hon.	5	0	0
Williams, W. W.	2	2	0
Williamson, F.	2	2	0

LIST OF DONATIONS AND CONTRIBUTIONS TO JUNE 1st, 1877.

DONATIONS OF BOOKS, MAPS, &c.

DONORS.	TITLE OF WORK.
<i>Agricultural Gazette</i> , Editor of the . . . }	"The Agricultural Gazette," 1876-77.
<i>Architect</i> , Editor of the . . . }	"The Architect," 1876-77.
Bath and West of England Agricultural Society . . . }	"Journal," Vol. VIII.
<i>British Architect and Northern Engineer</i> , Editor of the . . . }	"The British Architect and Northern Engineer," 1876-77.
<i>Builder</i> , Editor of the . . . }	"The Builder," 1876-77.
<i>Builders' Weekly Reporter</i> , Editor of the . . . }	"The Builders' Weekly Register," 1876-77.
<i>Building News</i> , Editor of the . . . }	"The Building News," 1876-77.
Clutterbuck, J. C. . . . }	Volume of "Tracts on Water Supply." By J. C. Clutterbuck.
Estate Exchange, Committee of the . . . }	"Index to the Estate Exchange Registers," 1876-77.
Farmers' Club, The . . . }	"Journal," February, March, & April, 1877.
<i>Field</i> , Editor of the . . . }	"The Field," 187 .
Freshfield, W. D. . . . }	"Dictionnaire raisonné du Mobilier Français." 6 vols. By Viollet-le-Duc.
Gedge, S. . . . }	"A Perambulation of Islington." By T. E. Tomlins.
Gouthwaite, R. . . . }	"System of Land Surveying at present adopted" (1805). By W. Stephenson.
Grantham, R. B. . . . }	"Geological Map of England and Wales." By G. B. Grenough. With Box and Fittings.
Grey, C. G. . . . }	"Memoir of John Grey, of Dilston." By J. E. Butler.
Higgins, C. . . . }	"Treatise on the Law relating to the Pollution of Watercourses." By C. Higgins.
<i>Horticulture, Journal of</i> , Editor of the . . . }	"The Journal of Horticulture," 1876-77.
Horwood, J. . . . }	"The Natural History of Wiltshire." By J. Aubrey.
	"Memoir of John Aubrey." By J. Britton.
Institution of Civil Engineers . . . }	"Minutes of Proceedings." Vols. XLIII., XLIV., XLV., XLVI., and XLVII.

DONORS.	TITLE OF WORK.
Institution of Mechanical Engineers	"Proceedings," May, July, October, 1876 and January, 1877.
	"Library Catalogue," 1876.
	"General Index to Proceedings," 1847 to 1873.
Lane, C. N., Col.	"The Natural History of Staffordshire." By R. Plot.
Leach, G. A., Col.	"Return of Commons and Common Field Lands."
London and Middlesex Archæological Society	"Transactions." Part XIV. Part I. of Vol. V.
	"Handbook of Rural Sanitary Science."
Marsh, L.	"The History and Antiquities of the Town, Hundred, and Deanery of Buckingham." By B. Willis.
North of England Institute of Mining Engineers	"Transactions." Vol. XXV., Session 1875-76.
	"A Practical Treatise on Heat." By T. Box.
Payne, W. P.	"Coke upon Littleton." 2 vols. Edition of 1669.
	"Three Tracts upon the Corn Trade and Corn Laws."
	"Builders' Prices for 1826." By J. Skyring.
	"Plans, Sections, and Elevations of Noblemen's and Gentlemen's Houses, &c." By J. Paine.
	"An Atlas of various Continental Towns, Rivers, Ports, Seas, &c."
Powell, R. C.	"History of the Isle of Wight. By R. Warner.
Ridley, G.	"Report (1875) on the Agriculture of the United States."
Royal Institute of British Architects	"Transactions." Session 1876-77.
	"Gardeners' Dictionary." By G. Don.
Sandy, H.	"Village and Cottage Architecture."
Smith, F.	"Minutes of Proceedings on Arbitration—Petre v. Corporation of Blackburn."
	"Journal," Vol. XXXIX., Parts II., III., and IV., and Vol. XL., Part I.
Statistical Society	"The Port and Docks of Birkenhead—Minutes of Evidence and Proceedings on the Birkenhead and Liverpool Docks Bills (1844 to 1852), &c." By T. Webster.
	"Reports and Notes of Cases on Letters Patent for Inventions." By T. Webster.
	Lewis' "Topographical Dictionary of Scotland and Ireland."
Webster, R. E.	
Will, J. S.	

INSTITUTION OF SURVEYORS.

List of Members, June 1st, 1877, with Council for Session 1877-78.

Date of Election
and of Transfer.

Honorary Members.

1874, Apr. 13	BEDFORD, HIS GRACE THE DUKE OF	81 & 82, Eaton Square, S.W.
1875, Mar. 15	CAIRD, JAMES, C.B.	{ Tithe and Inclosure Commission Office, St. James's Square.
1877, Jan. 15	CONSTABLE, JOHN, The REV. . . .	
1871, Jan. 30	GORE, CHARLES ALEXANDER, The HONORABLE	The Agricultural College, Cirencester.
1871, Jan. 30	HOWARD, JAMES KENNETH, The HONORABLE	Office of Woods, &c., 1, Whitehall Place.
'69, Jul. 26 } M.'71, Feb. 27 }	LEACH, GEORGE ARCHIBALD, { LIEUT.-COLONEL	Office of Woods, &c., 1, Whitehall Place.
1868, Jun. 23 } M.'77, May 14 }	LLOYD, JOHN HORATIO	Tithe and Inclosure Commission Office, St. James's Square.
'72, Jan. 15 } M.'72, Apr. 22 }	RIDLEY, GEORGE	100, Lancaster Gate, W.
		Tithe and Inclosure Commission Office, St. James's Square.

*The names of those Members and Associates who have paid Life Composition
Fees are distinguished thus **

Date of Election
and of Transfer.

Members.

1868, Aug. 3	ABBOTT, THOMAS.	22, Savile Row, W.
1868, Jun. 15	ADAMS, CHARLES FREDERICK	Barkway, Herts.
1872, Dec. 9	APPERLEY, WILLIAM HAVARD	Hereford.
1869, May 3	ARDING, CHARLES BENNETT.	22, Surry Street, Strand, W.C.
1870, Dec. 12	ARNOLD, GEORGE.	Dolton, North Devon.
1875, Nov. 8	AUSTIN, RUSSELL GARDINER	The Wash, Hertford.
1877, Mar. 12	BALLS, JAMES MAYHEW	Castle Hedingham, Essex.
1868, Aug. 17	*BARRY, CHARLES.	1, Westminster Chambers, Victoria Street, S.W.
1868, Aug. 3	BEADEL, FREDERICK.	25, Gresham Street, E.C.
1868, Jun. 15	BEADEL, WILLIAM JAMES	25, Gresham Street, E.C.
	(Member of Council)	
1868, Nov. 2	*BEAUMONT, GEORGE, JUN.	East Bridgford, near Nottingham.

*Date of Election
and of Transfer.*

MEMBERS

1876, Apr. 24	BECKETT, WILLIAM	Oulton Park Farm, near Tarporley, Cheshire.
1878, Dec. 8	BEESTON, FREDERICK	16, Walbrook, E.C.
1875, Mar. 1	BENNETT, THOMAS OATLEY, JUN.	Bruton, Somerset.
1873, Feb. 24	BEWICK, THOMAS JOHN	4, Broad Sanctuary, S.W.
1869, Mar. 22	BIDWELL, CHARLES	Ely, Cambridgeshire.
1875, Apr. 12	BINGHAM, REUBEN	5, Bolton Street, Piccadilly.
1868, Oct. 26	BINNIE, THOMAS	207, Hope Street, Glasgow.
1868, Aug. 10	BIRD, JAMES BINFIELD	West Cowes, Isle of Wight.
1870, Feb. 7	BLOUNT, WILLIAM	Orchehill House, Gerard's Cross, Bucks.
1874, Feb. 2	BOLAM, CHARLES GODFREY	Savernake Forest, Wiltshire.
1874, Feb. 2	BOLAM, HARRY GEORGE	Ingestre, Stafford.
1876, May 8	BOLAM, WILLIAM THOMAS	Newcastle-upon-Tyne.
1875, Dec. 18	*BOLDEN, JOHN LEONARD	Tehidy Office, Camborne, Cornwall.
1869, May 8	BOND, ERASMUS	22, Surry Street, Strand, W.C.
1868, Jun. 15	BONNY, JAMES RIPPOTH	47, Old Broad Street, E.C.
1868, Jul. 13	BOWLER, WILLIAM ANTHONY	Craven Chambers, Craven Street, W.C.
1868, Jul. 13	BRAVENDER, JOHN	Cirencester, Gloucestershire.
1874, Dec. 7	BROOK, JAMES	{ 28, John William Street; and Spring Wood, New Mill, Huddersfield.
1874, Dec. 7	BROUGHTON, JOHN	South Shields, Durham.
1874, Jan. 5	BROWN, DANIEL JOHNSON	61, Lincoln's Inn Fields, W.C.
1868, Jul. 13	BROWN, GEORGE	Roborough House, Barnstaple, Devonshire.
1871, Dec. 18	BROWN, JOHN	Rose Hill, Chesterfield.
1869, Feb. 22	BROWN, THOMAS FORSTER	Guildhall Chambers, Cardiff.
1869, Feb. 8	BROWN, WILLIAM	Tring, Herts.
1874, Apr. 13	BRYANT, ARTHUR JOHN	3, Old Palace Yard, Westminster, S.W.
1870, Dec. 12	BUCHAN, THOMAS	24, Bank Street, Dundee.
1868, Jul. 13	BUCK, ALBERT	Worcester.
1871, Dec. 18	BUCKLAND, FRANK BOWRY	Windsor.
1868, Jun. 15	BUCKLAND, VIRGOE	66, Cannon Street, E.C.
	<i>(Member of Council)</i>	
1868, Jul. 20	BURNELL, EDWARD HENRY	62, Bedford Row, W.C.
1875, Feb. 1	*BURROUGHS, THOMAS HENRY	Ketton, Rutlandshire.
A. '68, Aug. 10 } M. '75, Mar. 15 }	BUTLER, ARTHUR	7, Staple Inn, W.C.
1874, Jan. 5	BUZZARD, ALFRED LINDSEY	22, Surrey Street, Strand, W.C.
1869, Jul. 12	CADLE, CLEMENT	{ Clarence Street, Gloucester; and 52, Chancery Lane, W.C.
1876, Apr. 24	CASELL, JAMES ROBERT	11, Billiter Square, E.C.
1874, Jan. 19	CASTLE, HENRY JAMES, SEN. . . .	5, Chancery Lane, W.C.
1873, Jan. 13	CASTLE, ROBERT	Merton Street, Oxford.
1872, Mar. 11	CASTLE, WILLIAM HENRY BALDWIN	5, Chancery Lane, W.C.
1870, Dec. 12	CATES, ARTHUR	7, Whitehall Yard, S.W.
1875, Jan. 4	CAVE, HENRY H. . . .	Brigg, Lincolnshire.
1870, Jan. 10	CHANCELLOR, FREDERICK	Chelmsford, Essex; and 8, Finsbury Circus, E.C.

Year of Election
or of Transfer.

MEMBERS.

1868, Jun. 15	CHAPMAN, GEORGE	14, Cockspur Street, S.W.
1873, Jan. 27	CHEFFINS, CHARLES RICHARD .	23, Abingdon Street, S.W.
1868, Jul. 6	CHINNOCK, FREDERICK GEORGE	11, Waterloo Place, S.W.
1868, Jun. 15	CLARKE, THOMAS CHATFIELD .	63, Bishopsgate Street Within, E.C.
	(Member of Council)	
1868, Jun. 15	CLIFTON, EDWARD NORTON . .	7, East India Avenue, E.C.
	(Past President)	
1868, Jun. 15	CLUTTON, HENRY	9, Whitehall Place, S.W.
1868, Jun. 15	CLUTTON, JOHN	9, Whitehall Place, S.W.
	(Past President)	
1868, Jul. 13 } 1875, May 10 }	CLUTTON, JOHN HENRY . . .	9, Whitehall Place, S.W.
1873, Jul. 6 } 1874, Apr. 18 }	CLUTTON, RALPH	9, Whitehall Place, S.W.
1870, Jan. 10 } 1875, Dec. 18 }	CLUTTON, RALPH WILLIAM .	Hartswood, Reigate, Surrey.
1868, Jul. 13	CLUTTON, ROBERT GEORGE . .	9, Whitehall Place, S.W.
1869, Jan. 11	CLUTTON, WILLIAM JAMES . .	The Mount, York.
1868, Jun. 15	COBB, ROBERT LAKE	Higham, Kent.
1868, Jul. 20	COLLIER, JOHN	Salters' Hall, St. Swithin's Lane, E.C.
1868, Aug. 17	COLLINS, HENRY HYMAN . .	61, Old Broad Street, E.C.
1869, Apr. 5	COMELY, JOHN GILL	Winchester, Hants.
1869, Jan. 11	COOKE, CHARLES HENRY . . .	172, New Bond Street, W.
1876, Apr. 24	COOTE, GEORGE	Smeetham Hall, Sudbury, Suffolk.
1872, Jan. 29	COUCHMAN, CHARLES	6, Waterloo Street, Birmingham.
1868, Jun. 15	CRAWTER, HENRY	5, Bedford Row, W.C.
1869, Jan. 25	CRAWTER, JOHN	Cheshunt, Herts.
1869, Jan. 25	CRICKMAY, GEORGE RACKSTROW.	St. Thomas Street, Weymouth.
1874, May 11	CRONK, EDWYN EVANS	Sevenoaks, Kent.
1876, Jan. 10	CROSS, JOHN	Cross Street Chambers, Manchester.
1873, Apr. 21	CROSS, WILLIAM STEPHENS . .	53, Charing Cross, S.W.
1868, Jun. 15	CURREY, HENRY	37, Norfolk Street, W.C.
1877, Apr. 16	CURTIS, ROBERT LEABON . .	15 and 16, Blomfield Street, E.C.
1868, Jul. 13	DAVID, EDWARD	Llandaff, Glamorganshire.
1868, Nov. 2	DAVIDS, CHARLES HENRY . .	Banbury, Oxfordshire.
1873, Feb. 10	DAVIES, JOHN MORGAN . . .	Froodvale, Llandilo, Carmarthenshire.
1868, Jun. 15	DENT, JOHN	34, Great James Street, W.C.
1868, Jun. 15	DENTON, JOHN BAILEY . . .	22, Whitehall Place, S.W.
1868, Nov. 9	DOWNS, HENRY	Basingstoke, Hants.
1873, Feb. 10	DREW, HENRY	Exeter.
1872, Feb. 26	DREW, JOHN	{ 9, Queen Street, Exeter; and Powderham Castle, near Exeter.
1868, Jun. 15	DRIVER, ROBERT COLLIER . .	4, Whitehall, S.W.
	(Member of Council)	

*Date of Election.
and of Transfer*

MEMBERS.

1874, Jan. 5	DUNCH, CHARLES.	{ District Board Offices, White House, Commercial Road, E.
1871, Jan. 30	DUNLOP, ALEXANDER MILNE	3, Old Palace Yard, Westminster, S.W.
1868, Jun. 15	DYMOND, FRANCIS WILLIAMS	Exeter.
1868, Aug. 3	EASTON, WILLIAM	6, Hammet Street, Taunton, Somersetshire.
1868, Aug. 3	ELLCART, FERDINAND	40, Chancery Lane, W.C.
1875, Feb. 1	ELLIS, JOHN WHITTAKER, (Alderman)	{ 5, Lancaster Place, W.C., and 18, Old Broad Street, E.C.
1872, Feb. 26	EMMANUEL, BARROW	2, Finsbury Circus, E.C.
A 1874, Feb. 16 } M. 1876, Nov. 27 }	EVANS, WILLIAM ERNEST	33, Pride Hill, Shrewsbury.
1868, Aug. 3	EVE, WILLIAM	10, Union Court, Old Broad Street, E.C.
1873, May 5	EVES, GEORGE	Uxbridge, Middlesex.
1869, Jul. 26	FELTON, GEORGE	Llandudno, Carnarvon.
1873, Jan. 27	FIELD, FRANCIS HAYWARD	Merton Street, Oxford.
1872, Mar. 11	FOSTER, CHARLES ROLLS	54, Pall Mall, S.W.
1873, Dec. 8	FOWLER, WILLIAM	23, Waterloo Street, Birmingham.
1874, Jan. 5	FOX, FREDERICK FRANCIS	Melbourne, near Derby.
1875, Jan. 18	FRY, GEORGE FREDERICK	5, Tavistock Street, Covent Garden, W.C.
1868, Jun. 15	FULLER, FRANCIS.	8, Northumberland Avenue, S.W.
1876, Jan. 10	GAIRDNER, EDWARD JAMES	42, University Street, W.C.
1868, Jul. 6	GALSWORTHY, FREDERICK THOMAS	11, Waterloo Place, S.W.
1868, Sep. 28	GARDINER, WILLIAM JAMES	110, Great Russell Street, W.C.
1877, Feb. 12	GERMAN, WILLIAM	Measham, Atherstone, Derbyshire.
1875, Feb. 1	GILBERT, WILLIAM HENRY } SAINSBURY }	Wool Exchange, Coleman Street, E.C.
1869, Dec. 6	GIRDWOOD, JAMES	49, Pall Mall, S.W.
1876, Jan. 24	GLASIER, GEORGE HENRY } BROUGHAM }	41, Charing Cross, S.W.
1873, Feb. 10	GOUTHWAITE, RICHARD	Lumby, near South Milford, Yorkshire.
1875, Jan. 10	GRAHAM, WILLIAM	Victoria Chambers, Newport, Monmouthshire.
1875, Jan. 18	GREY, CHARLES GREY	55, Parliament Street, Westminster, S.W.
1876, Mar. 28	GWYTHYR, WILLIAM WARLOW	12, Beaufort Buildings, Strand, W.C.
1874, Mar. 16	HADDOCK, ROLAND	21, High Street, Croydon, Surrey.
868, Jun. 15	HALL, RICHARD	37, Great George Street, S.W.
	(Past President)	
868, Jul. 13	HALL, RICHARD, JUN.	37, Great George Street, S.W.
1868, Aug. 3	HALL, ROBERT WRIGHT	37, Great George Street, S.W.
1875, Jan. 4	HARDING, JOSEPH	49, Lune Street, Preston.
1875, Dec. 17	HARDING, WILLIAM DANIEL	16, St. Paul's Churchyard, E.C.

Date of Election
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MEMBERS.

1871, Feb. 23	HART, WILLIAM FREDERICK	16A, King's Road, Bedford Row, W.C.
1868, Jul. 13	HARVEY, JOHN	6, Victoria Place, Haverfordwest, Pembrokeshire.
1868, Jul. 13	HARVEY, RICHARD HART	6, Victoria Place, Haverfordwest, Pembrokeshire.
1873, May 19	HASLAM, DRYLAND	17, Friar Street, Reading.
1868, Jul. 6	*HAYWOOD, WILLIAM	Guildhall, London, E.C.
1877, Apr. 30	HEATH, WILLIAM HENRY	181, Bishopsgate Street Without, E.C.
1871, Jan. 16	HEDLEY, THOMAS FENWICK	Sunderland.
1870, Jan. 10	HILLIARD, GEORGE BRIDGE	Chelmsford, Essex.
1868, Jul. 13	HIPPISLEY, EDWIN	Chamberlain Street, Wells, Somersetshire.
1874, Nov. 16	HOLDEN, ISAAC	64, Cross Street, Manchester.
1874, Nov. 16	HOLDEN, JOHN	64, Cross Street, Manchester.
1868, Jun. 15	HORSEY, THOMAS	11, Billiter Square, E.C.
1869, Feb. 22	HORSFALL, RICHARD	Halifax, Yorkshire.
1869, Apr. 5	HORWOOD, JAMES	10, Paternoster Row, E.C.
1868, Sep. 28	HUDSON, WILLIAM	19, Bennet's Hill, E.C.
1868, Nov. 2	HUMBERT, CHARLES F.	Watford, Herts.
1869, Feb. 22	HUMPHREYS, CHARLES	61, Leadenhall Street, E.C.
1868, Jun. 15	HUNT, SIR HENRY ARTHUR, C.B.	45, Parliament Street, Westminster, S.W.
1874, May 11	HUNT, HENRY ARTHUR, JUN.	3, Victoria Street, Westminster, S.W.
1869, Mar. 8	HUNT, JOSIAH	6, Queen Anne's Gate, Westminster, S.W.
1868, Jun. 15	HUSKINSON, THOMAS	Epperstone, Nottingham.
	<i>(Past President)</i>	
1874, Jan. 19	HUSKINSON, WILLIAM LAMBE	The Manor House, Epperstone, Nottingham.
1869, Feb. 22	HUSSEY, GEORGE HENRY	The Green, High Wycombe, Bucks.
1868, Jun. 15	L'ANSON, EDWARD	7A, Laurence Pountney Hill, E.C.
	<i>(Member of Council)</i>	
1869, Jul. 26	JACKSON, FREDERICK	Nottingham.
1876, Apr. 3	JEMMETT, ALEXANDER	Murrell Hill Farm, Binfield, Bracknell, Berks.
1868, Jul. 27	JONAS, JOHN CARTER	27, Market Hill, Cambridge.
1873, Apr. 21	JONES, HENRY PARR	Portway House, Warminster.
1869, Mar. 22	KING, WILLIAM DAVID	Farlington Farm, Havant, Hants.
1868, Sep. 28	KNOLLYS, JAMES EDWARD	Fitzhead Court, Taunton, Somerset.
1871, Feb. 27	KNOWLES, WILLIAM	Albion Chambers, King Street, Gloucester.
1868, Aug. 3	LAMBERT, WILLIAM	4, New Basinghall Street, E.C.
1876, Apr. 24	LANE, CECIL NEWTON	King's Bromley Manor, Lichfield.
1868, Nov. 9	LAURANCE, JOHN, JUN.	Warmington, near Oundle, Northamptonshire.
1868, Jul. 20	LAVENDER, JOSEPH	26, Bedford Row, W.C.
1868, Jun. 15	LEE, CHARLES	8, Adelphi Terrace, W.C.
1874, Feb. 2	LEE, FREDERICK	6, Great College Street, Westminster, S.W.
1870, Feb. 7	LEES, JOHN	Reigate, Surrey.

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MEMBERS.

1875, Jan. 18	LLEWELLIN, DAVID	Pontypool, Monmouthshire.
1875, Jan. 15	LOFTS, HENRY	99, Mount Street, Grosvenor Square, W.
1876, Feb. 7	LOVEJOY, ALFRED	25, Queen Anne's Gate, Westminster, S.W.
1868, Aug. 3	LOVEJOY, WILLIAM	55, Chancery Lane, W.C.
1869, Jul. 12	LYE, JOHN GAUNT	8, Lancaster Place, W.C.
1868, Nov. 2	MACAULAY, COLIN ALEXANDER .	Leicester.
1869, Jan. 25	MANN, CHARLES JOHN	29, Great George Street, S.W.
1875, Jan. 18	MANN, ROBERT WILKS	7, Hobart Place, S.W.; and White Hall, Hayes.
1869, Mar. 29	MARR, JAMES	8, Adam Street, Adelphi, W.C.
1876, Mar. 20	*MARTIN, GILSON	Tavistock.
1875, Jan. 4	MARTIN, HOWARD	145, High St., Croydon; & The Ferns, E. Croydon
1870, Feb. 7	*MARTIN, JAMES	Wainfleet, Boston, Lincolnshire.
<i>(Member of Council)</i>		
1876, May 8	MARTIN, JOHN MAY	Lower Musgrave House, Exeter.
1868, Jun. 15	MARTIN, SAMUEL DICKINSON .	2, Beech Grove, Harrogate.
1875, May 10	MASON, WILLIAM LUDLAM . .	Louth, Lincolnshire.
1868, Jun. 15	MATHEWS, JEREMIAH	15, Waterloo Street, Birmingham.
1868, Jun. 15	*MATHEWS, WILLIAM, JUN. . .	15, Waterloo Street, Birmingham.
1876, Feb. 7	MCALL, GEORGE	4, Station Road, Blackburn.
1869, Feb. 8	MENZIES, WILLIAM	Parkside, Staines, Middlesex.
1877, Feb. 12	MINTER, WILLIAM	81, Bondgate, Darlington.
1874, Dec. 7	MOORE, EDWARD WELLS . . .	Middle Claydon, Winslow.
1876, Nov. 13	MORRIS, JOHN WARRINGTON .	Gracechurch Buildings, Gracechurch Street, E.C.
1874, Apr. 13	NAYLOR, ARTHUR MILLINGTON .	3, Old Palace Yard, Westminster, S.W.
1868, Nov. 2	NEALE, CHARLES JAMES . . .	High Oakham, Mansfield, Notts.
1872, Dec. 9	NEWMAN, FRANCIS	Ryde, Isle of Wight.
1875, Jan. 18	NICHOLS, DANIEL CUBITT . .	7, Howard Street, Strand, W.C.
1872, Jan. 29	NISBET, RALPH P.	Clarendon Chambers, 26 & 27, Villiers St., Strand
1873, Apr. 21	NOBLE, JOHN	Woodhall, Herts.
1875, Apr. 26	NOCKOLDS, MARTIN	Saffron Walden, Essex.
1876, Mar. 20	NORMAN, JAMES MAURICE . .	Uxbridge, Middlesex.
1869, Mar. 8	NORMAN, WILLIAM	8, Spring Gardens, S.W.
1868, Jul. 20	NORTH, GEORGE	22, Whitehall Place, S.W.
1871, Feb. 13	NOTLEY, RICHARD ALBERT . .	80, Cornhill, E.C.
1868, Jul. 6	*OAKLEY, CHRISTOPHER	10, Waterloo Place, S.W.
1868, Jun. 15	OAKLEY, JOHN	10, Waterloo Place, S.W.
<i>(Vice-President)</i>		
1877, Apr. 30	OAKLEY, WILLIAM	29, Charles Street, St. James's Square, S.W.
1869, Mar. 8	OWEN, THOMAS RULE	High Street, Haverfordwest, Pembrokeshire.
1872, Dec. 9	PARSONS, HENRY	Haslebury Plucknett, Crewkerne, Somerset.
1875, Nov. 8	PATERSON, ROBERT	10, Hanover Street, Edinburgh.

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MEMBERS.

1870, Dec. 12	PAXTON, JONAS	Bicester, Oxfordshire.
1868, Jun. 15	PENFOLD, JOHN WORNHAM (<i>Honorary Secretary</i>)	29, Great George Street, Westminster, S.W.
1876, May 8	PEPPERCORN, JOHN HUTCHINSON	Eaton Socon, Bedfordshire.
1876, Feb. 21	PHILLIPS, FREDERICK HAMILTON	Newtown, Montgomeryshire.
1878, Dec. 8	PINK, CHARLES	Winchester, Hants.
1870, Jan. 24	POUNDLEY, JOHN EDWARD	Black Hall, Kerry, Montgomeryshire.
1877, May 14	POWELL, EVAN	11A, Pall Mall East, S.W.
1868, Jul. 20	PRICKETT, GEORGE	62, Chancery Lane, W.C.
1872, Nov. 25	PRICKETT, WALTER BELLSON	62, Chancery Lane, W.C.
1877, May 14	PRIOR, RICHARD JAMES	Canterbury, and 61, Lincoln's Inn Fields, W.C.
1870, Jan. 24	RAWLENCE, GEORGE	Salisbury, Wilts.
1870, Feb. 7	RAWLENCE, JAMES	Salisbury, Wilts.
1868, Oct. 26	RAYNBIRD, HUGH EDWARD	Basingstoke, Hants.
1876, Dec. 18	RICHARDSON, JOHN	Methley Park, Leeds.
1873, Feb. 10	RICKMAN, THOMAS MILLER	8, Montague Street, Russell Square, W.C.
1868, Jun. 15	RIGDEN, RICHARD HENRY	The Close, Salisbury, Wilts.
1868, Aug. 17	ROBERTS, RICHARD	25, Laurence Pountney Lane, E.C.
1868, Jul. 13	ROBINS, EDWARD COOKWORTHY	14, John Street, Adelphi, W.C.
1872, Dec. 9	*ROBSON, EDWARD ROBERT	{ 20, Great George Street, Westminster; and 6, St. German's Place, Blackheath, S.E.
A. '74, Dec. 7. } M. '76, Jan. 24. }	ROLLESTON, JOHN FOWKE LANCLOT	{ Grey Friars, Leicester.
1868, Aug. 31	ROSSER, WILLIAM	Llanelly, Carmarthen.
1870, Feb. 21	RUSHWORTH, EDMUND	22, Savile Row, W.
A. '78, Dec. 8. } M. '76, Nov. 8. }	RUSHWORTH, EDMUND WALTER	22, Savile Row, W.
1868, Jun. 15	RYDE, EDWARD (<i>Vice-President</i>)	29, Great George Street, S.W.
1876, Jan. 24	SADLER, GEORGE WILLIAM	467, High Street, Cheltenham.
1875, Apr. 26	SANDAY, GEORGE HENRY	Wensley House, Bedale, Yorkshire.
1876, Nov. 27	SANDY, HENRY	Newport Road, Stafford.
1869, Feb. 8	SAUNDERS, CECIL GEORGE	29, Great George Street, S.W.
1869, Feb. 22	SAUNDERS, EDWARD	6, Bishopsgate Street Without, E.C.
1863, Aug. 17	SAVILL, ALFRED	3, St. Helen's Place, E.C.; and Chigwell, Essex.
1874, Feb. 2	SCARTH, WILLIAM (<i>Member of Council</i>)	Raby Castle, Darlington.
1869, Mar. 8	SCOTT, THOMAS COLVILLE	19, King's Arms Yard, E.C.
1875, Mar. 1	SEARLE, FRANCIS WILLIAM	Marsh House, Tottenham, Middlesex.
1871, Jan. 16	SEDGWICK, ALFRED OTHWAITE	Watford, Herts; and 49, Bedford Row, W.C.
1875, Mar. 1	SHACKEL, GEORGE	161, Friar Street, Reading, Berks.
1876, Mar. 6	SHAW, JOHN	College Place, Derby.
1868, Jul. 13	SHOPPEE, CHARLES JOHN (<i>Member of Council</i>)	61, Doughty Street, W.C.
1875, Apr. 26	SIMONDS, JOHN CABOURN	Fishloft Manor, Boston, Lincolnshire.
1872, Apr. 22	SLATER, GEORGE	Canterbury.

*Date of Election
and of Transfer.*

MEMBERS.

1868, Oct. 26	SMELLIE, THOMAS DAVIES . . .	209, St. Vincent Street, Glasgow.
1868, Aug. 17	SMITH, CHARLES BOVILL . . .	Wickham, Hants.
1868, Jul. 13	SMITH, CHARLES JOHN . . .	10, Waterloo Place, S.W.
1868, Jun. 15	SMITH, EDMUND JAMES . . .	16, Whitehall Place, S.W.
	(President)	
1872, Feb. 26	SMITH, THOMAS TAYLER . . .	33, Bloomsbury Square, W.C.
1868, Aug. 10	SNOOKE, WILLIAM . . .	6, Duke Street, London Bridge, S.E.
1868, Nov. 9	SOUTHWELL, CHARLES JOSIAH . . .	9, Whitehall Place, S.W.
1868, Jul. 27	SPACKMAN, HENRY . . .	6, Terrace Walks, Bath.
1868, Jun. 15	SQUAREY, ELIAS PITTS . . .	{ 22, Great George Street, S.W.; and The Moot, Downton, Salisbury.
	(Member of Council)	
1871, Feb. 13	ST. QUINTIN, PERRY . . .	37, Threadneedle Street, E.C.
1868, Aug. 17	STANLEY, HENRY . . .	Bury St. Edmund's, Suffolk.
1868, Jun. 15	STATTER, THOMAS . . .	Standhall, Whitefield, Manchester.
1877, Jan. 15	STENNING, ALEXANDER ROSE . . .	27, Fenchurch Street, E.C.
1868, Jun. 15	STEPHENSON, CHARLES . . .	45, Parliament Street, Westminster, S.W.
	(Member of Council)	
1876, Jan. 24	STEPHENSON, CHRISTOPHER . . .	Woburn, Bedfordshire.
1868, Jul. 27	STEWART, HERBERT THOMAS . . .	3, Victoria Street, S.W. *
1868, Jul. 20	STURGE, ROBERT FOWLER . . .	34, Corn Street, Bristol.
1868, Jun. 15	STURGE, WILLIAM . . .	34, Corn Street, Bristol.
	(Vice-President)	
1874, Feb. 16	SWORDER, GEORGE EDWARD . . .	Bishop's Stortford, Herts.
1875, Feb. 15	SWORDER, WILLIAM . . .	Stapleford Tawney Hall, near Romford, Essex.
1874, Jan. 19	THOMAS, JOSIAH . . .	Athenæum Chambers, Nicholas Street, Bristol.
1868, Jun. 15	THYNNE, EDWARD LEWIS . . .	11, Great George Street, S.W.
1869, Jan. 11	THYNNE, FREDERICK GEORGE . . .	11, Great George Street, S.W.
1875, Jan. 18	TOLLEY, JAMES . . .	66, Cannon Street, E.C.
1877, Jan. 29	TOOTELL, JOSEPH . . .	Maidstone, Kent.
1877, Jan. 29	TOOTELL, RICHARD WILLIAM . . .	12, Furnival's Inn, Holborn, E.C.
1876, Apr. 24	TOWER, BROWNLOW RICHARD CHRISTOPHER . . .	{ Little Ingestre, Stafford.
1868, Jun. 15	TRIST, GEORGE . . .	62, Old Broad Street, E.C.
1874, May 11	TROLLOPE, CHARLES BROWN . . .	13, Parliament Street, Westminster, S.W.
1868, Jun. 15	TRUMPER, RICHARD . . .	23, Lincoln's Inn Fields, W.C.
1868, Aug. 3	TUCKETT, PHILIP DEBELL . . .	10A, Old Broad Street, E.C.
1869, Feb. 8	TURNER, WILLIAM . . .	1, Butter Market, Ipswich, Suffolk.
1876, Feb. 21	VERNON, ARTHUR . . .	Borshams, High Wycombe, Bucks.
1876, Jan. 20	VIGERS, ASTLEY . . .	4, Frederick's Place, E.C.
1871, Dec. 4	VIGERS, EDWARD, JUN. . . .	15, Parliament Street, Westminster, S.W.
1868, Jun. 15	VIGERS, FRANCIS . . .	4, Frederick's Place, E.C.
	(Member of Council)	
1868, Jun. 15	VIGERS, ROBERT . . .	4, Frederick's Place, E.C.
1872, Dec. 9	VULLIAMY, GEORGE . . .	{ Metropolitan Board of Works, Spring Gardens, S.W.

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MEMBERS.

1868, Aug. 8	WALLEN, JOHN	155, Leadenhall Street, E.C.
1869, Jan. 25	WARING, THOMAS	21, Queen Street, Cardiff.
A. '69, Mar. 8. } M. '75, Apr. 12. }	WARNER, WILLIAM HENRY	99, Mount Street, Grosvenor Square, W.
1868, Jun. 15	WATNEY, DANIEL (<i>Member of Council</i>)	62, Old Broad Street, E.C.
1872, May 6	WEALL, JOHN, JUN.	Rugby House, Pinner, Middlesex.
1869, Dec. 6	WEBB, GEORGE	Tunstall, Sittingbourne, Kent.
1868, Jul. 20	WESTBURY, GILES	Andover, Hants.
1868, Nov. 9	WHICHCORD, JOHN	12, Queen Victoria Street, Mansion House, E.C.
1874, Apr. 27	WIDNELL, FREDERICK GRAINGER	13, Parliament Street, Westminster, S.W.
A. 1870, Feb. 7 } M. 1876, Nov. 13 }	*WIGRAM, JOHN	South Collingham, Newark, Notts.
1868, Jul. 20	WILLIAMS, GEORGE BARNES	Frederick's Place, E.C.
1870, May 9	WILLIAMS, STEPHEN WILLIAM	Rhayader, Radnorshire.
1876, Mar. 6	WILLIAMSON, FRANCIS	31, Castle Gate, Nottingham.
1868, Aug. 10	WILLMOT, FRANCIS	33, Waterloo Street, Birmingham.
1873, May 19	WIMBLE, JOHN	9, Queen Victoria Street, Mansion House, E.C.
1868, Jun. 15	WITHALL, RICHARD AUGUSTUS	29, Great George Street, Westminster, S.W.
1868, Jun. 15	WOOD, FREDERICK	Albert House, Rugby, Warwickshire.
1868, Jul. 13	WOOD, WILLIAM BRYAN	Chippenham, Wilts.
1873, Feb. 10	WOODCOCK, RICHARD	20, Darlington Street, Wolverhampton.
1868, Jul. 6	WOODHOUSE, JOHN THOMAS	Midland Road, Derby.
1875, Mar. 1	WOODTHORPE, EDMUND	2, Coleman Street Buildings, Moorgate St., E.C.
1868, Jun. 15	WOOLLEY, THOMAS SMITH (<i>Vice-President</i>)	South Collingham, Newark, Notts.
A. 1871, Nov. 13 } M. 1877, Jan. 29 }	WOOLLEY, WILLIAM EDWARD	Loughborough, Leicestershire.
1872, Dec. 9	WRIGHT, WILLIAM EDWARD	King's Lynn, Norfolk.
1872, Apr. 22	*WRIGHT, WILLIAM	Wollaton, Nottinghamshire.
1876, Feb. 21	YEOMAN, GEORGE DUNDAS	Law's House, Turvey, Bedfordshire.

Associates.

Date of Election.

1876, Mar. 20	ACLAND, SIR THOMAS DYKE, BART., M.P.	} Killerton, Exeter.
1868, Nov. 2	BADCOCK, PHILIP	9, Whitehall Place.
1868, Jul. 27	BARRY, JOHN WOLFE	23, Delahay Street, Westminster, S.W.
1875, Dec. 18	BATTEN, JOHN WINTERBOTHAM	3, Harcourt Buildings, Temple.
1876, Dec. 18	BAZALGETTE, CHARLES NORMAN	1, Essex Court, Temple.
1868, Nov. 9	BEAUCHAMP, CHARLES DAVIE	9, Whitehall Place, S.W.
1869, Feb. 22	BIDDER, GEORGE PARKER, JUN., Q.C.	} 3, Paper Buildings, Temple.
1875, Feb. 1	BIDWELL, SHELFORD	9, Whitehall Place, S.W.
1875, Feb. 1	BIRCH, ROBERT WILLIAM PEREGRINE	} 5, Westminster Chambers, S.W.
1876, Apr. 8	BIRCHAM, SAMUEL	46, Parliament Street, Westminster, S.W.
1875, Feb. 1	BLAKEWAY, JOHN	Talbot Chambers, Shrewsbury.
1868, Jun. 23	BRAMWELL, FREDERICK JOSEPH	37, Great George Street, Westminster, S.W.
1870, Dec. 12	CARDALL, FREDERIC WILLIAM	9, Whitehall Place, S.W.
1869, Jul. 26	CARLISLE, WILLIAM THOMAS	8, New Square, Lincoln's Inn, W.C.
1870, Feb. 7	CARRITT, ERNEST	10, Coleman Street, E.C.
1871, Feb. 18	CASTLE, EDWARD JAMES	4, Brick Court, Temple.
1870, May 9	CATLING, ROBERT CHARLES	Needham Hall, Elm, Cambridgeshire.
1876, Nov. 13	CLARKE, DANIEL	Easton Street, High Wycombe, Bucks.
1876, Feb. 7	CLAYDEN, WALTER	6, Queen's Terrace, Ilford, Essex.
1874, Jan. 5	COOKE, WILLIAM GEORGE	3, Vine Terrace, York Road, S.E.
1876, Dec. 18	COX, JAMES PONSONBY, COLONEL	81, Onslow Square, S.W.
1870, Jan. 10	CRAWLEY, WILLIAM JEEVES	10, Waterloo Place, Pall Mall.
1875, Mar. 1	CRUSE, EDMUND	Warminster, Wiltshire.
1875, Feb. 15	DALE, JOHN	16, Whitehall Place, S.W.
1875, Apr. 26	DASHWOOD, FREDERICK LOFTUS	Kirtlington, Oxford.
1868, Nov. 9	DEAN, HENRY	Southam, Rugby, Warwickshire.
1869, Feb. 8	DODGSON, WILFRED LONGLEY	The Moor, Ludlow.
1869, Jan. 25	DOWDEN, HENRY JOSEPH	4, Whitehall, S.W.
1876, Jan. 10	DRIVER, CHARLES WILLIAM	4, Whitehall, S.W.
1869, Jun. 28	EASTON, EDWARD	23, Delahay Street, Westminster, S.W.
1874, Apr. 27	EDWARDS, JOHN, Q.C.	1, Harcourt Buildings, Temple.
1877, Apr. 16	EDWARDS, JOHN FREDERICK JAMES	} 37, Great George Street, Westminster, S.W.

<i>Date of Election.</i>	<i>ASSOCIATES.</i>	
1869, Feb. 8	FAWCETT, JAMES POGUE	5, Lancaster Place, W.C.
1869, Feb. 22	FOWLER, JOHN	2, Queen Square Place, S.W.
1876, Mar. 20	FRESHFIELD, WILLIAM DAWES . .	5, Bank Buildings, E.C.
1877, Mar. 12	FULTON, HAMILTON	7, Vigo Street, Regent Street, W.
1868, Jul. 27	GARRARD, ARTHUR	17, Finsbury Square, E.C.
1876, Dec. 18	GEDGE, SYDNEY	1, Old Palace Yard, S.W.
1872, Apr. 8	GEPP, THOMAS MORGAN	Chelmsford, Essex.
1874, Feb. 16	GOLDNEY, GABRIEL PRIOR . . .	3, Essex Court, Temple, W.C.
1873, May 19	GORE, SPENCER W.	16, Whitehall Place, S.W.
1877, Feb. 12	GOTTO, FREDERICK EDWARD . .	Ely, Cambridgeshire.
1869, Jan. 11	GRANTHAM, RICHARD BOXALL . .	22, Whitehall Place, S.W.
	<i>(Associate of Council)</i>	
1874, Jan. 5	GRANTHAM, RICHARD FUGE . . .	22, Whitehall Place, S.W.
1877, Mar. 26	HARDING, EDWARD ERNEST . .	16, St. Paul's Churchyard, E.C.
1877, Mar. 26	HARDING, WILLIAM DANIEL, JUN. .	16, St. Paul's Churchyard, E.C.
1876, Dec. 18	HARRISON, WILLIAM GEORGE, } Q.C.	11, King's Bench Walk, Temple.
1875, Dec. 13	HIGGIN, WILLIAM HOUSEMAN, } Q.C.	4, St. James' Square, Manchester.
1875, Jan. 4	HILL, ALEXANDER STAVELEY, } Q.C., M.P., &c., &c. . . .	3, Garden Court, Temple; and Oxley Manor, Stafford.
1870, May 23	HOLLWAY, JOHN GEORGE	Lamb Building, Temple, W.C.
1868, Jul. 20	HORSLEY, RICHARD	11, Bull-and-Mouth Street, E.C.
1869, Feb. 8	HUBBERSTY, HENRY ALFRED . .	Buxton, Derbyshire.
1873, Feb. 10	INGRAM, WALTER FEILDE . . .	89, Chancery Lane, W.C.
1870, Jan. 24	JOHNSTON, ANDREW	25, Gresham Street, E.C.
1869, Apr. 5	JONAS, HENRY	4, Whitehall, S.W.
1875, Dec. 13	KAYE, JOHN EDWARD	25, Gresham Street, E.C.
1870, May 23	KEELE, EDWARD RUSHWORTH . .	5, Frederick's Place, Old Jewry, E.C.
1873, Apr. 21	*KING, WILLIAM	Gas Office, Duke Street, Liverpool.
1874, Feb. 2	LEDGARD, FREDERICK THOMAS } DURELL	4, Elm Court, Temple, W.C.
1868, Jul. 6	LEE, CHARLES WILLIAMS	8, Adelphi Terrace, W.C.
1876, Apr. 3	LEE, GEORGE CANSFIELD	North Eastern Railway, York.
1873, Jan. 27	LERMIT, ALFRED WILLIAM . . .	5, Chancery Lane, W.C.

<i>Date of Election.</i>	<i>ASSOCIATES.</i>	
1874, Feb. 16	LITTLER, RALPH DANIEL MAKIN-SON, Q.C.	} 1, Plowden Buildings, Temple, W.C. 12, Great George Street, S.W. Tooting Graveney, S.W.
1869, Mar. 8	LOTT, JOSEPH	
1877, May 14	LUCAS, JOSEPH	
1876, Jan. 15	MARRIOTT, GEORGE WHARTON .	Horstead, Norwich.
1874, Feb. 16	MARRIOTT, WILLIAM THACKERAY, Q.C.	} 6, Crown Office Row, Temple, W.C.
1876, Nov. 18	MARTIN, CHARLES WILLIAM .	
1875, Jan. 4	MICHAEL, WILLIAM HENRY .	1, Great Queen Street, S.W.
1869, Jan. 25	NASH, ALFRED JAMES	Farnham, Surrey.
1875, Dec. 13	NEVILLE, HENRY WILLIAM . .	Broadway Chambers, Westminster, S.W.
1875, Feb. 1	NEWMAN, GEORGE GUNNELL .	75, Cornhill, E.C.
1874, Feb. 2	NIXON, SAMUEL	29, Great George Street, S.W.
1875, Nov. 8	PAIN, COARD SQUAREY	4, Cook Street, Liverpool.
1876, Apr. 24	PARKER, FREDERICK SEARLE .	17, Bedford Row, W.C.
1875, May 10	PAYNE, WILLIAM PERCY . . .	{ Midland Railway Station, Derby; and 136, Mansfield Road, Nottingham.
1872, Nov. 11	PAYNE, WILLIAM SETH ROBERT	
1869, Dec. 6	PETRE, HENRY WILLIAM, THE HON.	Springfield, Chelmsford, Essex.
1869, Feb. 22	PHILBRICK, FREDK. ADOLPHUS, Q.C.	Lamb Building, Temple.
	<i>(Associate of Council)</i>	
1875, Jan. 4	PLEDGER, JOSEPH AUGUSTUS .	Great Baddow, Chelmsford.
1874, Feb. 16	POWELL, REGINALD HENRY . .	Lewes, Sussex.
1871, Feb. 27	QUICK, JOSEPH, JUN.	{ 29, Great George Street, S.W.; and Sumner Street, Southwark, S.E.
1868, Nov. 9	REES, JOHN CHARLES	
1869, Feb. 8	REX, WILLIAM	311, Kentish Town Road, N.W.
1876, May 8	RICH, ROBERT	{ Sarsden Estate Office, near Chipping Norton, Oxfordshire.
1876, Jan. 24	ROBERTS, CHARLES	
1874, Feb. 2	ROBERTS, CHARLES GAY	Haslemere, Surrey.
1871, Feb. 13	ROGERS, ARUNDEL	1, Paper Buildings, Temple.
1874, Mar. 2	ROGERS, SYDNEY JAMES	5, Westminster Chambers, S.W.
1876, Dec. 18	RYDE, ARTHUR LYON	29, Great George Street, Westminster, S.W.
1875, Nov. 8	RYDE, EDWARD HARROW	60, Warwick Square, S.W.
1871, Feb. 13	SHIELD, HUGH	3, King's Bench Walk, Temple.
1877, Jan. 29	SHOPPEE, CHARLES HERBERT .	61, Doughty Street, W.C.

<i>Date of Election.</i>	<i>ASSOCIATES.</i>	
1870, Mar. 21	SMITH, CHARLES JOHN . . .	16, Whitehall Place, S.W.
1876, May 8	SMITH, HENRY	8, John Street, Adelphi, W.C.
1875, Apr. 26	SMITH, HENRY HERBERT . . .	6, Whitehall, S.W.
1868, Jul. 27	SMITH, HERBERT EDMUND . . .	Darlington, Durham.
1869, Jan. 11	SMITH, WILLIAM BINNS . . .	50, Pall Mall, S.W.
1868, Nov. 9	SMYTH, EDWARD	{ 9, Whitehall Place; and 100, Stockwell Park Road, S.W.
1876, Mar. 20	ST. QUINTIN, RICHARD SAMUEL	37, Threadneedle Street, E.C.
1875, Dec. 13	STRUTT, EDWARD GERALD, THE HON.	{ Terling Place, Witham, Essex.
1875, Jan. 4	STRUTT, FREDERICK, THE HON.	88, Eaton Square; and Milford House, Derby.
1870, Feb. 7	TATHAM, GEORGE HENRY . . .	27, Southampton Buildings, Chancery Lane, W.C.
1869, Jul. 26	TAYLOR, GEORGE.	{ Tithe and Inclosure Commission Office, St. James's Square.
1872, Mar. 11	TAYLOR, JOHN	Earsdon, Northumberland.
1876, May 8	THESIGER, ALFRED HENRY, THE HON., Q.C.	{ 1, Brick Court, Temple.
1870, Feb. 21	THOMPSON, CHARLES WILLIAM .	Vacant Lands' Office, Guildhall, E.C.
1871, Feb. 13	TOLMÉ, JULIAN HORN	1, Victoria Street, Westminster, S.W.
1874, Apr. 27	TREVELYAN, HARINGTON ASTLEY, COL.	{ Sandrock Villa, 5, Elm Tree Road, N.W.
1868, Jul. 20	TROLLOPE, GEORGE FRANCIS . .	15, Parliament Street, Westminster, S.W.
1874, Jan. 19	USILL, GEORGE WILLIAM . . .	3, Great Queen Street, Westminster, S.W.
1873, Dec. 8	VENABLES, FREDERICK	Hadley, Barnet.
1876, Dec. 18	WATTS, CHARLES	37, Great George Street, Westminster, S.W.
1876, Nov. 27	*WEBSTER, RICHARD EVERARD .	2, Pump Court, Temple.
1871, Feb. 13	WHITE, FREDERICK MEADOWS, Q.C.,	4, Paper Buildings, Temple.
1873, Jan. 27	WHITE, THOMAS JENNINGS . . .	8, Whitehall Place, S.W.
1876, Dec. 18	WILL, JOHN SHIRESS	3, Pump Court, Temple.
1875, Jan. 18	WILLIAMS, LEONARD JAMES . . .	6, Furnival's Inn, E.C.
1869, Apr. 5	WILLIAMS, RICHARD PRICE . . .	9, Great George Street, S.W.
1876, Apr. 3	WILLIAMS, WILLIAM WELSBY . .	Llandaff, Glamorganshire.
1877, Jan. 29	*WILSON, RODERIC JOHN . . .	24, Old Square, Lincoln's Inn, W.C.
1869, Dec. 6	WILSON, WILLIAM	13, Dean's Yard, S.W.
1870, Jan. 10	WING, THOMAS TWINING	17, Woburn Square, W.C.
1875, May 15	WINCKWORTH, LEWIS	31, Abingdon Street, Westminster, S.W.
1876, Feb. 7	WOOLLEY, THOMAS CECIL SMITH	South Collingham, Newark, Notts.
1876, Apr. 24	WYATT, ROBERT	Acton Hill, Stafford.

*Date of
Admission.*

Students.

1876, Jul. 13	BURMESTER, JOHN WILLIAM	} 4, Spencer Villas, Southfields, Wandsworth.
	STANLEY	
1877, May 14	COSENS, ALLAN	Lime Tree House, Kew Bridge, Chiswick.
1875, Feb. 26	DRIVER, ROBERT MANNING .	Melrose House, Cromwell Rd., S. Kensington, S.W.
1876, Nov. 27	EILOART, FREDERICK EDWARD.	40, Chancery Lane, W.C.
1875, May 31	LLOYD, GEORGE	50, Laurel Grove, Penge, Surrey.
1876, Nov. 13	NEWMARCH, BERNARD	32, Bedford Row, W.C.
1876, Nov. 27	PAULL, HENRY BAYNHAM . . .	36, Cambridge Street, Eccleston Square, S.W.
1875, Nov. 8	SHOPPEE, CONRAD JOSEPH . .	61, Doughty Street, W.C.
1875, Feb. 1	SMITH, GEORGE CECIL	16, Whitehall Place, S.W.
1873, Nov. 10	THOMSON, JAMES ALFRED . . .	The Nurseries, Wimbledon.
1874, Dec. 7	VIGERS, LESLIE ROBERT . . .	4, Frederick's Place, Old Jewry, E.C.

Members and Associates are particularly requested to communicate any changes of address to the Secretary, in order to obviate delay in the transmission of the Papers, &c., to which they are entitled.

END OF VOL. IX.







